TEXTILE WASTES -

A Bibliography

By

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INTRODUCTION

Pollution from industrial wastes is one of the most challenging phases of the National program for water pollution control today. The textile industry, cognizant of this serious problem, has long been concerned about its stream pollution potential due to the prodigious quantities of water used in its processes. To alleviate this problem, many mills have built treatment facilities which are quite costly. Others are using municipal sewage treatment systems. These latter systems, in many instances, have become dangerously overloaded due to a steadily increasing population and industrial growth. Consequently, the industry is turning more and more to in-plant control systems to reduce its total effluent.

Surveys have indicated that more than half of the stream pollution potential in textile finishing plants effluent is produced by the fabric desizing operation. Based on this survey data, in May 1965 a feasibility study concerning the recovery of wastes from the desizing of fabric as an approach to the alleviation of stream pollution by textile processing operations was initiated at North Carolina State University, School of Textiles.\(^1\) The study was sponsored by the United States Department of the Interior through the Water Resources Research Institute of the University of North Carolina as authorized under the Water Resources Act of 1964, Public Law 88-379. The objectives initially were to examine the possibilities of recovering existing sizing agents and to examine the possibilities of using materials of known ease of recovery from aqueous solution as possible sizes. At the same time, a search of the chemical literature concerning sources of pollution from textile mills, especially warp-size wastes, was made for the period 1954-1964.\(^1\) It was found that

\(^1\)The work was conducted by R. N. Berrier and H. Y. Jennings, Department of Textile Chemistry.
essentially no effort had been made during this time in the field of recovery and reuse of chemicals as a means of abating stream pollution.

In 1968, again under the sponsorship of the Water Resources Research Institute of the University of North Carolina, the School of Textiles undertook to correct, update, and publish a bibliography of literature references relative to textile wastes as stream pollutants. No effort was made to include abstracts of literature published prior to 1954 as these were already available in other publications. This study includes abstracts published in the Chemical Abstracts, Textile Technology Digest, Shirley Institute Abstracts, and Water Pollution Abstracts through June, 1968.

This bibliography has been key-word coded in a limited way and indexed to aid in the retrieval of information. The coding, wherever possible, was done according to the Thesaurus of Engineering Terms, published by the Engineers Joint Council, 345 East 47th Street, New York, New York. The abstracts are listed alphabetically by author's last name and are numbered consecutively under each letter of the alphabet.
KEY WORD INDEX

Acidification:
E4, F6, H1, L1, L6, L13, L15, N8, P16, R4, R10.

Acid Treatment:
A68, H23, K25.

Activated Sludge Process:
A7, A13, A14, A29, A38, A39, A67, B3, B4, B25, B34, C10, C14, D3, D5, D9, I5, J5, K2, K3, K4, K6, K7, K19, K37, K41, M26, M37, P6, P12, R3, R11, S36, S37, S41, T2, T10, Z3.

Adsorption:
C14, K40, K41, R13.

Aeration:

Aerobic Processes:

Agitation:
A11, B40, D8, M33.

Alkaline:

Aluminum:
C2, C3, H30, K11, K17, M17, M39, P22.

Anaerobic Processes:

Analyzing:
A13, A33, B1, B8, B9, B29, D1, F8, H14, H18, H19, H20, H22, J3, L4, L10, L13, L15, M11, N9, O4, O5, P15, P19, R12, R13, S17, S24, S38, W13.

Applying:
H9.

Basic Data:
B29, B38, I3.

Bentonite:
C12, F6.

Bibliographies:
A15, A17, A19, A25, B21, B28, B38, H3, H5, H15, H16, H17, H18, H19, H20, H21, I6, J4, K18, K28, K29, K30, L2, M6, M7, M9, M10, M44, O1, O2, O3, P8, S2, S33, S45, S51, S64, T7.

Biochemical Oxygen Demand - Analysis:

Biochemical Oxygen Demand - Reduction:

Biological Treatment:

Bleaches:
I5, V1.
Bleaching:

Blending:
B29, C2, C3, F7, D8, J5, M32, W16.

Butylacetate:
K32.

Calcium Chloride:
A35, A54, A65, A9, C5, F7, M2, M17, M38, N8, P7, S35, T6.

Carboxymethylcellulose:
A23, B36, C12, D5, H92, M4, S31.

Centrifugal Filtration:

Characteristics:
A17, B13, B14, B17, C13, D1, H7, I7, K10, K13, K18, K40, L4, L5, N15, O2, O6, V4, W14, Z4.

Chemical Process:
A3, A34, G7, K6, K17, K19, M17, M20.

Chlorides:
C4, K11, M39, P15, S17, S19, I2.

Clarification:
B33, C14, F3, F4, I1, K11, K17, K18, K19, K40, M15, M29, N14, N16, O7, P2, P13, S15, S19, S20, S55, V6, Z1, Z2.

Color:
H8, H30, J6, J8, K34, M17, M47, N6, R13, S63.

Colorimetry:
I1, I3.

Coagulation:
C4, F6, H7, H3, H30, L1, L6, M2, M3, M39, M39: R1, R12, R13, S49, S55, W11.

Composition:
A2, A64, C13, D1, G7, K10, K36, M12, N2, N13, N20, O6, O7, V1.

Contamination:
A40, A63, B12, B33, H12, M17, V4, W3.

Control System:
C13, F8, G6, H10, H27.

Cost Analysis:

Cotton:
A17, A22, A23, A34, A48, A57, B1, B39, C2, C3, C12, D5, D6, H7, H30, J6, K6, K10, L5, L8, M17, M20, M21, M24, N1, N3, N4, N6, N12, N15, O2, P19, R10, S29, S31, S38, S46, S52, S53, W11, Y1, Z3.

Counter Current Washing:
K38, S11.

Data:
A11, B8, B34, H7, I3, K26, M2, M20, M24, N20, F7, S4, S30, S37, S46, V1.

Decoloring:
A24, D8, H7, I1, J5, M3, M17, M33, N2, N7, N14, N17, S7, S37, S41.

Degradation:
A29, B8, B10, B11, B23, B38, B40, H30, K17, S64.

Desizing:
A23, A34, A45, B32, B33, B39, D5, M21, M36, O2, R7, W15.

Detergents:
A20, A40, B8, B26, C9, C11, C12, D8, H26, H30, I5, J6, K3, K11, K21, K24, K30, K37, M9, M25, M37, R12, S13, S44, S57, S63, S64, V4, W6, W8, Z5.
Diagrams, Tables, Illustrations:
A9, A25, A45, A47, A64, B1, B16, C10, D10, G4, H27, K10, K33, L5, M17, P18, R3, R8, W3.

Dialysis:
H7, N6.

Drainage Systems:
E1.

Drum Vacuum Filters:
A54.

Dyeing:

Dyes:

Economic Factors:
A30, B14, K15, T1, W2, W18.

Efficiency:
A8, A11, A29, N3, R3, S37, W13, Y1.

Effluents:

Effluents (continued):
M26.

Engineering Economy:

Enzymes:
A29, A34, D5, M36, W15.

Equilization:
B24, C12, N21, P19, W12, S30.

Equipment:
A32, A34, E1, G4, H9, H10, H31, K11, K18, K26, K27, P11, S21, S60, W6.

Experimentation:
A9, A11, A24, B26, B29, B34, B39, D5, D10, H7, H30, I3, K10, K41, L5, L7, L15, M2, M17, M37, M39, N14, N21, O7, P7, P18, R3, R11, S37, S46, S55, V1, Y1.

Extraction:
A40, M36, P11, V4.

Fibers:

Filtration:

Finishing:
A22, A34, A57, B10, B11, B24, B34, C2, C3, C12, D10, G8, G9, H9, H24, K4, K13, K19, L3, L9, M17, M21, N23, M33, N3, N4, C2, P9, P11, P22, P7,
Finishing (continued):

Flocculating:
A52, C14, D8, H30, I2, K3, K17, K18, L6, M33, P9, P22, R8, S20, S22, S32, W18.

Floation:

Flue Gas:
C14, H7, K41, N12, S53.

Gassification:
W18.

Greases:
A9, A28, A54, B26, B40, F6, F7, H7, K38, L15, M2, N8, P7, T6, V4, W3.

Ion Exchangers:
A3, A31, A40, A68, K37, M35, R10, W9, W17, W18.

Impurities:

Industrial Wastes:
A1, A2, A3, A18, A25, A33, A37, A38, A40, A48, A53, A61, A66, B2, B3, B16, B17, B18, B19, B20, B21, B28, B38, B41, C1, C7, C8, D2, G2, H4, H17, I2, I6, J1, J2, J3, J4, K18, K27, K36, L1, L2, L5, L12, M26, M30, N2, N5, P1, R2, R4, R9, S2, S8, S18, T1, W3, W12.

Installing:
A3, A26, A57.

Iron:
K16.

Iron Compounds:
C2, C3, D8, I1, I3, K10, K17, K18, K26, M33, M39, N16, N21, W16.

Lagoons:

Lanolin:
A59.

Legislation:
A14, A34, A37, A41, A48, B30, E3, G6, G8, H6, I7, K37, L9, M7, O2, P10, R2, R6, S1, S21, S44, S63, T1, T7, W1.

Lime:
D8, N21, O2, P18.

Magnesium:
N14, O2.

Measurement:
B9.

Neutralizing:
A21, A29, B24, H10, H12, N3, O2, P10, R7, S37, S49, S63, W3.

Nitrogen:
A13, A14, C12, S50, T10, V6, W17.

Organic Acids:

Organic Chemicals:

Oxidation:

Oxygen:
A13, A14, A53, D9, G2, J8, K17, L3, M26, M30, M41, P3, S22, V1.

Paper:
A41, H29, K18, K29, M9.
Perculating Filters:
A21, A54, A57, C12, C14, D5, H7, N17, S37.

Peroxide:
A34, C6.

pH:

Pilot Plant:

Pollution:
A8, A14, A15, A17, A49, A53, A55, A56, A68, B5, B14, B27, B30, C6, D8, G1, H8, H32, J2, J9, K30, K36, L5, L9, L14, M8, M12, M20, M23, M33, P26, R9, S4, S15, S43, S47, S54, S63.

Pollution Abatement:

Potassium:
B40, N8.

Precipitation:

Procedures:
H12, J5, R8, S8, S38, S39.

Processing:

Purification:

Qualitative Analysis:
B14, C8, K31, M6, M7, N16.

Radio-Active Wastes:
A13, A14, H18.

Rag Pulp:
L8.

Rayon:
A2, H1, L2, L8, L11, P18, S4, S11.

Recovering:

Reduction:
B38, C14, N7.

Research:

Resins:
A31, A38, A56, A68, R8, R10, S5.

Results:
Sizing:
A32, E4, E5, G1, S27.

Sorption:
B12, C14, D9, G4, K40, K41
R8, S55.

Spinning:
L15, M17, P19, V4.

Starch:
A23, A38, A45, B3, B4, B13,
B32, B33, B34, B36, B39, C12,
D5, H30, I5, M4, M5, M20, M21,

Starch Derivatives:
B13, H6, L7, M5.

Statistics:
B8, D10.

Subsurface Drainage:
A22, A41, C2, C3, T1.

Substitute Chemicals:
A48, B36, D5, H30, M5, M20,
M21, M22, M25, S29, S31, S39,
Z4.

Sulfur Compounds:
A13, A40, B2, B22, B23, F1, F4,
F5, G3, I1, I2, I5, K5, K25,
K39, L6, L13, M16, M41, P2, P3,
P15, P16, R13, R14, S19, V4, Z1,
Z4.

Surfactants:
B6, B7, B23, D9, K14, K21, K23,
L10, M40, M45, R8, S1, S13, S54,
V2, Y1, Z4.

Symposium:
A48, A50, A58, A64, M19, S27.

Synthetic Fibers:
A2, A18, A52, B22, B35, C2, C3,
C13, D2, F4, F5, G2, G3, H25,
J6, K1, K3, K5, K39, L2, L6, L8,
M13, M14, M15, M16, M17, M18,
M23, M24, M29, M39, M41, M42,
M43, M46, O2, P2, P3, P13, P14,
P18, R3, S3, S4, S11, S19, S20,
S26, S31 S49, T8, T10, T11, W11,
Z1.

Synthetic Resins:
K11, S29.

Systems Engineering:
A9, A34, A57, B16, B30, B31,
B40, H8, H9, H27, H29, K11,
K18, K26, L4, M8, M12, M18,
O1, P12, S10, S28, S32, T7,
W7, W11.

Textile Plant Effluents:
A4, A7, A15, A17, A19, A21,
A22, A24, A25, A26, A30, A34,
A35, A45, A47, A48, A50, A54,
A57, A58, A64, A65, B1, B13,
B16, B17, B24, B27, B30, B31,
B32, B33, B34, B37, B39, C2,
C3, C4, C7, C10, C12, C13,
C14, D1, D3, D4, D7, D10, E2,
F2, F4, G1, G5, G7, G10, H2,
H6, H13, H15, H16, H17, H18,
H19, H20, H21, H22, H23, H26,
H28, H30, H31, I4, I5, J5, J6,
J7, J8, K4, K6, K7, K10, K11,
K12, K13, K14, K16, K17, K18,
K13, K26, K27, K29, K35, K40,
L4, L5, L8, L9, L10, L15, M3,
M4, M5, M8, M17, M20, M22,
M24, M26, M27, M33, M35, M37,
M6, K11, N13, N14, N15, N16,
N17, N18, N20, O1, O2, O3, O6,
P6, P11, P12, P19, P20, P22,
R1, R4, R7, R8, R11, R12, R13,
R14, S4, S6, S7, S9, S10, S15,
S16, S21, S22, S24, S25, S26,
S28, S29, S30, S32, S35, S36,
S37, S38, S39, S40, S41, S42,
S46, S59, S63, T3, T4, T6, V1,
V3, V4, V6, W7, W11, W14, W16,
Y1, Z3, Z5.

Tin Compounds:
A17, A29, B30, H30, I5, M3,
N20, S4, S53, S58.

Transferring:
V1.

Trickling Filters:
A17, A29, B30, H30, I5, M3,
N20, S4, S53, S58.

Turoflocc:
K11.
Toxicology:
   D1, L14, P19.

Trade Associations:
   S34.

Utilization:
   H6, K12, L8, S18.

Viscose Rayon:

Waste Disposal:

Waste Treatment:

Wastes:
   A18, A26, A29, A36, A37, A38, A58, A61, B11, B17, B19, B26, B27, B29, B30, B37, B38, B40, C6, D1, D2, D5, D6, F7, G1, H7, H9, H10, H11, H12, H20, H30, J2, J6, J8, K2, K17, K36, L8, M3, M16, M23, M38, M47, N1, N3, N4, N7, N16, N17, N18, O5, O6, P7, P18, R10, R14, S3, S4, S8, S12, S19, S22, S42, S47, S54, S61, T2, T7, T8, T11, V1, V5, W13, Z6.

Waste Waters:

Water:
Water Pollution:
A5, A13, A23, A40, A46, A55, A58,
A62, A63, B6, B7, B9, B17, B27,
C8, C11, C13, C1, E2, E10, H3,
H5, H12, H15, H16, H17, H18, H19,
K20, K21, K30, K32, J2, J9, K29,
K29, K30, K36, M1, M4, M8, M20,
M25, M31, M46, N9, O2, O3, O4,
O5, P8, P10, S7, S34, S38, S42,
S44, S45, W6.

Water Resources:
A8, A37, A53, A58, B14, G6, T5.

Water Treatment:
A13, A14, A28, A39, A41, A49,
A96, H1, I4, I7, J1, K8, K9, K14,
K40, M9, N10, N18, P21, Q1, R5,
R13, S62, W9, W17.

Waxes:
A11, A19, B40, F7, D10, L15,
M21, M25, N6.

Wool:
A2, A10, A26, A35, A59, A62, B26,
C5, C9, D4, E4, J6, K30, K38, L8,
M2, M3, M17, M25, N21, O4, C7.

Wool Grease:
A10, A65, B26, C5, C9, E4, K27,
N8, S63.

Wool Scouring:
A9, A10, A11, A19, A28, A54, A65,
B15, B26, B40, C5, C9, E4, F6,
H15, H16, H17, H19, H20, H21, M2,
O2, P7, S2, S56, S57, S63, T2,
T6, T9, V4, W12.

Zaremba:
P11.
Textile Waste Bibliography


4. Akhmedov, K. M., and I. M. Garibov. "Methods for Removing Sulfur Dyes from Wastes from the Dyeing Plant of the V. I. Lenin Bakin Textile Works. Tekh. Progress, (5), p. 41-43, 1966. (In Russian) Experiments were made with wastes containing 600 mg./l. sulfur dyes. A 10% H₂SO₄ solution (250-750 mg./l.) and 0.1% solution of polyacrylamide (2 mg./l.) were added to the sewage, stirred 2 minutes, and left to settle for 0.5 hr. The residual concentration of sulfur dyes was 0-100 mg./l.


7. Alspaugh, T. A. "Progress and Developments in Treatment of Integrated Textile Mill Wastes." Proc. 12th sth. munic. industr. Waste Conf., p. 46-62, 1963. Following studies on modifications of the activated-sludge process suitable for use with integrated textile waste waters at the Cone Mills Corporation, Greensboro, N. C., a full-scale plant was constructed to treat 21 mil. gal. per week by the 24-hour high-solids activated-sludge process in which the longer aeration period and the higher solids
As shown in a flow diagram, the textile waste waters pass through two storage lagoons in series (to provide equalization and some removal of lint and dye paste) and are mixed with 10% of screened and degritted domestic sewage before entry into the aeration tank, which is equipped with Vortair surface turbine aerators. After final sedimentation the effluent is chlorinated and re-aerated before discharge to a creek, while sludge is returned to the aeration tank, the excess being bled off to a gravity thickener before charge to the city sewer. Operating data are tabulated, showing an average BOD removal of 89-90% and colour removal of 50-75%. Further studies are in progress to solve the problems of foaming in the aeration tanks; light, poorly-settling sludge; disposal of excess sludge; and removal of colour. The problem of foaming is accentuated by the high conc. of synthetic detergents in textile waste waters, and of various methods of control tested the most successful appear to be spraying with crude waste water, alone or with the addition of anti-foaming agents (these agents being used in rotation to overcome loss of effectiveness); spraying with waste water combined with the dripping or spraying of anti-foaming agent on to the rotor blades; and possibly the removal and destruction of foam by a vacuum pump (which might also permit the conc. and recovery of detergent). The poorly-settling sludge which occurred during certain periods of operation was found to contain heavy growths of algae, similar to filamentous forms of Sphaerotilus, which were favoured by aerobic conditions in the return sludge. The problem could be overcome by allowing the sludge to become septic before return to the aeration tank, or by introducing a shock load of organic material (by cutting out some of the aeration rotors for a period); both these methods reduce the conc. of oxygen and destroy the algae. However, these algae have good characteristics for removal of BOD and colour, and it might be possible to design the treat. plant to take advantage of this, although the sedimentation tanks would need to be very large. Excess sludge from the treat. of textile waste waters is difficult to settle and concentrate. Rates of vacuum filtration and centrifugation are low compared with sewage sludge and large doses of chemicals are required. At present the sludge is discharged to the municipal sewer to study the effects it will have on the anaerobic digestion and vacuum filtration of domestic wastes. Other promising methods of disposal appear to be vacuum filtration and centrifugation, in each case followed by incineration. In studies on methods for improving the removal of colour, trace amounts of \( \text{Fe}_2(\text{SO}_4)\text{3} \) were ineffective as a catalyst for removal of colour in the aeration process; further tests are to be carried out using chlorination.

by reducing the volume of the waste waters and by treatment. The need for improved management of water resources to provide adequate supplies for growing industrial development is stressed.

9. Anderson, C. A. "Aeration Recovery of Lanolin from Wool Scour Liquors". (flow sheets and illustrations) Textile Res. J., 30, p. 51-57, 1960. Investigation of the aeration process has resulted in an improved design for a continuous recovery plant. On a pilot scale the design has permitted throughput rates about \( 2\frac{1}{2} \) times greater than previous designs, with equal recovery efficiencies.


11. Anderson, C. A. "Factors Affecting Recovery of Wax from Wool Scouring Liquors". Textile Inst., 53, p. 401-409, 1962. In the centrifugal method for the recovery of wax from wool scouring liquors, yields are usually low and experiments have therefore been carried out on factors affecting recovery of the wax. It was found that recovery, which is reduced with increased oxidation of the wax, is greater from the scouring of base portions of the fleece than from tip portions. More wax is recovered from liquors from the scouring of lambs, locks and crutching wools than from the fleece wools. In many liquors, the larger drops in the disperse phase are not preferentially recovered by centrifuging; however, vigorous agitation, which reduces the drop size, also reduces recovery and in practice, care should be taken to avoid excessive pumping and agitation of the liquors. Excessive use of soap in scouring reduced the yield of wax; this appears to be due to alternations in the composition of the drops and not to any change in size distributions of the disperse phase. Storage of the liquors was found to have no adverse effect on wax yield, although in some cases there is a change in the distribution of wax between the effluent and sludge phases.

12. Anderson, C. A. and G. F. Wood. "Investigations into the Centrifuging of Wool-Scouring Liquors for Wool-Grease Recovery. I. The Primary Centrifuge." J. Text. Inst., 57, p. T55-T64, 1966. Centrifuges are frequently used for the recovery of grease from wool-scouring liquors, and experiments were carried out using an Alfa-Laval sludge-discharge centrifuge, type FVK4, to determine the effect of various factors on grease recovery. It was found that percentage recovery was independent of temp. in the range \( 57^\circ - 82^\circ C \) and of feed rate in the range \( 1000-1400 \) gal./hr., but was inversely proportional to the gravity-disk diameter. In general the centrifuge was inefficient at settings that gave very low or very high conc. of grease in the product, the optimal conc. being 15±5 \%; procedure is described for adjusting the centrifuge for optimal production.

topics are discussed: methods of analysis, including determination of metals, nitrogen, oxygen, BOD, organic compounds, sulphur compounds and suspended solids; laboratory control of sewage treat.; treat. of sewage by physical and chemical methods, biological filtration, and activated-sludge process; disinfection of sewage; effects of detergents in water and sewage, and studies on degradation of detergents; sludge digestion; disposal and utilization of sludge; lagoons for sewage and waste waters; re-use of sewage-works effluents; treat. of waste waters from canneries, sugar refineries, dairies, meat packing, fermentation, pharmaceutical and chemical works, coal mining and processing, metal pickling, oil refineries, plating of metals, pulp and paper mills, tanneries and textile and wool industry; methods of treat. and disposal of radioactive wastes; biology of polluted water; biological indicators of pollution, microbiology of polluted waters; pollution by chemicals; oxygen sag and self-purification; stream standards; surveys of surface waters; legislation and control of pollution; effects of pollution on water supply; and pollution of estuarine and sea water.

14. Anon. "A Review of the Literature of 1964 on Waste Water and Water Pollution Control". U. S. Water Pollution Control Federation. J. Wat. Pollut. Control Fed., 37, p. 587-646, 735-799, and 887-979, 1965. In a review of literature published during 1964 on treat. of sewage and trade waste waters and on the control of water pollution, the following subjects are considered: general analytical methods; determination of organic carbon, pesticides, phenolic compounds, organic compounds, metals, inorganic anions, nitrogen compounds, and dissolved oxygen; laboratory control of sewage treat.; biological filtration; the activated-sludge process; disinfection of sewage and water; effects of synthetic detergents and removal of detergents from waste waters; sludge digestion; disposal and utilization of sludge; lagoons; re-use of sewage effluents; composting of garbage; treat. of waste waters from canneries, starch and sugar factories, dairies, meat packing, fermentation, pharmaceutical and chemical industries, coal industry, metal pickling and plating, oil industry, pulp and paper mills, tanneries, and textile and wool industry; methods for treat. of radioactive waste waters and recovery of radionuclides; removal of radioactivity from water and sewage; underground and marine disposal of radioactive wastes; uptake of radioactivity by bottom deposits and aquatic organisms; measurement of radioactivity and methods for continuous monitoring; biology of polluted waters; water quality requirements for fish; biological effects of pollution by sewage, detergents, industrial waste waters, and pesticides and weedkillers; algae, fungi, and bacteria in polluted waters; methods for biological estimation of pollution; effects of radioactive pollution; microbiology and chemistry of polluted waters; the oxygen sag and self-purification; use of stream standards; surveys of polluted waters; legislation and control of pollution; effects
of pollution on water supplies; pollution of ground water and polluting effects of ground-water recharge; pollution of estuaries and sea water; and disposal of waste waters at sea.


21. Anon. "Biological Treatment of Highly-Alkaline Textile Mill Waste-Sewage Mixture". Proc. Amer. Soc. Civ. Engrs., 81, (750), 4 pages, 1955. Pilot-plant studies were made on the biological treatment of a mixture of textile manufacture waste waters and sewage on percolating filters, without previous neutralization of the high alkalinity. The waste waters, with a pH value of 10.5, were mixed with sewage in the proportion of 4 per cent waste water to 96 per cent sewage, the amount of waste water gradually increased to 40 percent, and the mixture applied to the experimental filter at a BOD loading of 2.73 lbs./sq. yd. Examination of the filter effluent showed a reduction in BOD of 51 per cent, and in color of 42.5 per cent; the pH value was 9.1. A total reduction in BOD of 58 per cent was obtained after final sedimentation.
22. Anon. "Bleachery Wastes Treated by Nutrients and High-Rate Filter Plant". Wastes Eng., 26, p. 452-453, 1955. A treatment plant was constructed in 1948 at Mansfield Bleachery, Mansfield, Massachusetts, to provide treatment for the general mill wastes and the alkaline and acid process wastes that are discharged from the cotton-finishing mill. The plant is designed to treat a maximum flow of 1 mgd by primary sedimentation, aeration, high-rate biological filtration and second sedimentation, recirculated to the aeration tank. The final effluent can be discharged to the river, or stored in a lagoon from which it seeps into the ground. It is necessary to add supplementary N and P to the waste waters. Sludge is disposed of in a lagoon.

23. Anon. "CMC Kayoed Stream Pollution". Textile Ind., 124, (10), p. 161-162, 1960. At the Dan River Mills, Inc., Virginia, 50-60% of the pollution load discharged to the Dan River resulted from the cotton desizing wastes, and particularly during the summer with low flows and high water temperatures, the oxygen concentration in the river was reduced below state standards. Experiments showed that the BOD of the waste waters could be reduced by using CMC instead of starch in the sizing process, and this has now been used in full-scale operation for over a year.

24. Anon. "Color Removal from Azo Dye Works". Proc. Amer. Soc. Civ. Engrs., 84, (SA2), Pap. No. 1611, 4 pages, 1958. In this report of the Sanitary Engineering Research Committee, Industrial Wastes Section of the American Society of Civil Engineers, the results are given of experiments on the treatment of ten typical azo dyes which are frequently used in the textile industry, with stannous chloride. The color of the dyes was completely destroyed by heating at 212°F for 2 hours in the presence of a small amount of stannous chloride.


26. Anon. "Effluent Treatment at a Yorkshire Mill". Textile Weekly, 64, (1), p. 509-510 and 533, 1964. The Flygt pumping installation described is said to be able to move water heavily laden with textile fibers and has been installed in Britain by a woolen and worsted manufacturer, dyer, and finisher. Installation and running costs were found to be low. In 18 months of operation it is claimed that no repair or servicing costs have occurred.

28. Anon. "Effluent Treatment Plants. Installation at Spinning Works in Devon." Water & Water Eng., 68, p. 115, 1964. The important design and operating features of the new plant installed to treat waste waters from the scouring of woollen yarn and cloth at the works of the Buckfast Spinning Company Ltd., Devon, are described. The waste waters are discharged to a holding tank where the pH value is adjusted and the emulsion is then pumped to an autoclave where it is subjected to steam heating, pressurizing, and cracking. The discharge from the autoclave is collected in another tank, the oils, fats and greases rising to the top and being decanted, stored, and eventually reprocessed. The pH value of the remaining liquor is adjusted before dilution with other waste waters and discharge to the municipal sewer.


   1. Southway - special problems in Britain.
   2. A. H. Little - An account of requirements of River Boards and local authorities receiving discharges into
sewage system. Best place for textile effluent was in the local authority sewer although pretreatment might be necessary.

3. Chesner and Roberts – "Effluent studies with bleaching liquors". 70 to 90% of BOD load from mill due to processing chemicals and only 10 to 30% due to the fiber. Enzyme desizing followed by a caustic boil produced four times the BOD load of persulfate desizing followed by peroxide bleach.

4. L. J. Smith – outline of plant type required for the purification of the effluent likely to be discharged from textile mills.

35. Anon. "Pretreatment Plant for Wool Factory Effluent; Wear and Tees River Board". Engineer, 214, p. 601, 1962. A new technique using calcium chloride as the reagent reduces the BOD load to about 1500 lb./day is described. In operation at Head Wrighton Processes Ltd., Imperial Chemical Industries Ltd., and Patons and Baldwins Ltd.


38. Anon. "Proceedings of the 21st Industrial Waste Conference". Parts 1 and 2. Sponsored by Purdue Univ. and Ind. State Board of Health. May 3-5, 1966. Purdue University, Lafayette, Ind. 1017 pages. Eng. Extension Series No. 121. $13.50. The following papers of particular interest to the textile industry are included:


4) "Utilization of Resistant Proteins (e.g. Keratin) by Activated Sludge" by G. J. Capestany (Municipality of Metropolitan Seattle) and D. A. Carlson (Univ. of Washington), p. 943-952.
39. Anon. "Process for Treating Water". British Patent 955,321 to Esso Research and Engineering Company. A process is claimed for removing water-soluble organic compounds from sewage-works effluents and trade waste waters which are free from suspended solids. High-molecular compounds, particularly low concentrations of non-biodegradable water-soluble compounds, such as synthetic detergents, are removed by foam fractionation, and low-molecular organic compounds are then removed by electrodialysis or adsorption on activated carbon. A design is also claimed for a treatment plant incorporating an activated-sludge unit, foam-fractionation column, and apparatus for collapse of foam by heating or agitation. Effluent from the activated-sludge tank is passed to the foam-fractionation column, or, alternatively, if foam is present in the activated-sludge tank it may be skimmed off and passed direct to the foam-collapsing apparatus. Gas is taken from the aeration tank and supplemented with air for use in foaming. Fine bubbles are used and the bubble size and acidity must be controlled carefully. The rate of gassing must be adjusted to maintain a distinct foam-liquid interface and a stable foam must also be maintained (by using a foam column of narrow diameter and, if necessary, adding a small amount of alkylbenzene-sulphonate to increase the foam stability of weakly surface-active contaminants). The collapsed foam can be recirculated to the foam-fractionation column to further concentrate the organic impurities which are subsequently oxidized to carbon dioxide and water at high temperature and pressure. Alternatively, organic compounds, such as phenol, could be recovered from the collapsed foam by solar evaporation. When used to treat secondary sewage effluents, the process removed 87 per cent of the alkylbenzenesulphonate (leaving a concentration of less than 0.1 mg. per litre) and 32 per cent of the chemical oxygen demand. The process has also been used to remove organic water-soluble dyes from textile industry waste waters.

40. Anon. "Removing Detergents from Waste Waters; New Low-Cost Methods". Mod. Textiles Mag., 44, (10), p. 44, 1963. A new "liquid ion exchange" process developed by General Mills is described. Cook Machinery Company is to market the new system that makes possible the recovery of the reagent for continuous use. The principal chemicals consumed are sulfuric acid and sodium hydroxide. This system can be adapted to many areas where removal of contaminants in discharge water is important.


43. Anon. "Reports on the Progress of Applied Chemistry". Soc. of Chemical Industry, Vol. XLVIII, 800 pages, 1963. London. Progress in the various branches of applied chemistry is reviewed, with a comprehensive list of references appended to each chapter. The following are among the subjects considered.

1) "Sewage, Trade Wastes and River Pollution". J. McNicholas. p. 322-333. This review covers legislation to control pollution of surface waters and beaches, and studies on river pollution; effect of polluting materials on fish; storm sewage; percolating filters, activated-sludge process; sludge treatment; effects of synthetic detergents; treatment of trade waste waters; and instruments for the control and monitoring of sewage-treatment processes.

2) "Biodegradability of Detergents". D. W. G. Dicker. p. 334-342. Current progress in the development of "biologically-soft" anionic detergent materials and the control of "hard" materials is outlined, followed by a review of work on the measurement of biological degradability and its relation to molecular structure; studies on non-ionic detergents, since their relative contribution to pollution will increase as biologically-soft anionic detergents come into general use; and studies on the toxicity of surface-active agents and the removal of alkylbenzenesulphonates from waste waters.

3) "Microbiology of Water, Sewage and Industrial Effluents". L. A. Allen. p. 532-541. This chapter covers the microbiology of water, especially sewage-polluted water, and of waste-treatment process, particularly the various modifications of the activated-sludge process and the treatment of carbonization, cyanide, cellulose-manufacture and other trade waste waters.

4) "Sampling for Bacteriological Examination". B. M. Gibbs. p. 541-549. Included in this review are sampling devices and techniques for the microbiological examination of water and mud. Other chapters of the report contain information on the disinfection of water by chlorination (p. 566) or ozonation (p. 602), demineralization of sea water using soluble phthalocyanine dyes to increase the rate of solar evaporation (p. 54), and the use of plastic pipes for drinking water (p. 622).


45. Anon. "Simple Bio-Aeration Kills Strong Wastes Cheaply". Chem. Eng., 70, (1), p. 40 and 42, 1963. The prolonged aerobic stabilization process developed by R. H. Souther has now been installed at a plant at Haw River, North Carolina, to treat a mixture of textile waste waters and domestic sewage, and at several other plants in North Carolina and Georgia. The advantages of this process, which can treat strong starch desizing wastes along with dyes and other waste waters are indicated. The operation of the process is described briefly, and a flow diagram of the plant is given.


48. Anon. "Symposium on Waste-Disposal Problems of Southern Mills". Am. Dyestuff Reprtr., 44, (12), p. 379-400, 1966. Papers on Relation of Federal stream pollution to laws and industry; Cotton slashing with synthetic compounds as means toward pollution abatement; Bleaching and dyehouse waste studies; Textile waste treatment in Texas; Biological treatment of mixture of highly alkaline textile-mill waste and sewage; Classification of streams in Georgia, South Carolina and North Carolina; Pollution control by recovery of caustic soda.

49. Anon. "Textile Effluent Treatment and Disposal". Cotton Silk and Man-made Fibres Research Association, Manchester (Shirley Institute Pamphlet No. 92) 92 pages, 1966. Papers read at a conference on 17th November, 1965, are presented: "Planning for Trade-Effluent Disposal" by P. C. G. Isaac (pp. 9-34), "Treatment of Waste Waters from the Textile Industry" by A. B. Wheatland (pp. 35-59), "Pollution by Textile Effluents in the Mersey Basin" by C. Lumb (pp. 60-76), and "Stratification in Sedimentation Tanks" by A. H. Little (pp. 77-92).


52. Anon. "The Second International Man-Made Fibre Symposium - 1965 in Berlin". Faserforsch. u. Textiltech., 16, (7), p. 363-371, 1965. In German. Short reports of the following papers are published together: "The polymerization of L-amino carboxylic acid lactams" by P. Schlack; "Reaction mechanisms in polyethylene terephthalate melts" by H. Zimmermann and others; "Fibre formation from polypropylene and modified polypropylene" by F. Geleji and others; "A study of stretching processes in polypropylene" by M. Jambrich, I. Diacik, and P. Hravnak; "The influence of processing and finishing on glass fibre properties" by W. Bobeth, R. Barthel, and G. Wiedemann; "Two structural classes among man-made fibres" by N. V. Michajlov; "The paracrystalline fibrillar structure in polyethylene which has been drawn and tempered by various methods" by R. Housemann, F. J. Balta Celleja, and W. Wilke; "An investigation of the supramolecular structure of man-made fibres" by A. E. Paksver and L. S. Gerasimova; "The state of solution of high polymers" by C. Ruscher; "New studies on the solution state in cellulose solutions" by J. Schurz; "Physico-chemical studies of the supramolecular structure of high strength regenerated cellulose fibres" by B. Philipp and J. Baudisch; "Investigations of structural changes in cellulose during the viscose process, with the aid of deuterium exchange and infrared techniques" by G. Wlodarski; "Possible methods of structure formation in regenerated cellulose fibres" by H. Klare and others; "On the formation of viscose fibres" by V. Beseda, M. Kozler, and F. Lauko; "Kinetic studies on the breakdown of xanthic acids" by Z. Cichowski; "The normal solution properties of viscose with respect to ultra filtration and flocculation behaviour" by A. Matthes, A. Grundling, and M. Roszberg; "Recent trends in the development of modern cellulose chemistry" by Z. A. Rogovin; "Some results from the grafting of cellulose and cellulose derivatives with vinyl monomers" by C. Simionescu; "Characterization of viscose and viscose solution" by E. Treiber; "The origin of transverse periodic changes in inorganic, organic and synthetic fibre structures" by H. Dolmetsch; "The chemical changes in cellulose and regenerated fibres caused by heat treatment" by H. Sihtola and L. Neimo; "Process water and effluent treatment in man-made fibre production units" by J. Kaeding; "Water and the regenerated cellulose industry" by W. Voss; "The important properties of man-made fibres and their test methods" by H. Bohringer.

53. Anon. "The Somerset River Board. Thirteenth and Fourteenth Annual Reports and Statements of the Accounts". 72 pages, 4 plates (1st April 1962 to 31st March 1963), 68 pages, 6 plates (1st April 1963 to 31st March 1964). These reports contain information on water resources, fisheries, and prevention of river pollution, with individual consideration of the principal rivers including causes of pollution and remedial action. Sewage fungus has again been found in various rivers in the area, particularly below the outfalls from small sewage works, a cheese factory, and a paper mill, and better maintenance of the small sewage works is recommended to produce
better effluents. Mortality of fish in the river Brue was found to coincide with the occurrence of high salinity in the river resulting from infiltration of sea water at Highbridge. The fish died when the chloride concentration exceeded 11,000 p.p.m., and the river appeared to recover when the concentration of chloride decreased to below 7000 p.p.m. The standards applied to effluents take into account the flow and velocity of the river, the amount of water available for dilution, the self-purifying capacity, and the use made of the river water downstream of the outfall. For fully-treated sewage and trade waste waters receiving an adequate dilution of clean river water with sufficient purifying capacity, the standard is normally less than 20 p.p.m. BOD and 30 p.p.m. suspended matter, but where the river is slow-running and the dilution available is less than 8 times, a higher standard is required.

In an attempt to determine the most suitable type and grade of medium for percolating filters treating cloth-manufacturing waste waters, the plant installed at the factory of Fox Bros., Wellington, to treat half the waste waters, includes a filter divided into four sections with three different media. In addition to detailed chemical and biological surveys of some non-tidal rivers in the area, a survey has been made of the tidal waters of the river Parrett to investigate the effects of untreated sewage and trade waste waters; in conjunction with the Water Pollution Research Laboratory measurements were made of the hydraulics of the river, the polluting load being discharged, and the chemical state of the water with particular reference to the concentrations of dissolved oxygen and chloride. A large part of the tidal section of the river was found to be seriously polluted. Hydrographic surveys have also been made in connection with the location of outfalls for the proposed discharge of sewage from Burnham U.D.C. into the tidal waters of the river Parrett, from Nailsea New Town (Long Ashton R.D.C.) and adjoining villages into the Bristol Channel west of Clevedon, from Portishead U.D.C. into Redcliffe bay near Black Nore, and from Kewstoke (Axbridge R.D.C.) into Woodspring bay.


Anon. "Wastes Treatment Plant for Cotton Finishing Industry, Saylesville, Rhode Island". Wastes Eng., 26, p. 397 and 414, 1955. The plant for treatment of the waste waters at a mill of the Sayles Finishing Plant, Inc., at Saylesville, Rhode Island, has recently been greatly enlarged to treat more adequately the heavy mill wastes. High-rate percolating filters now supplement the original low-rate percolating filters. The extended plant consists of primary sedimentation tanks; low-rate percolating filters, cinder filters and high-rate percolating filters; secondary sedimentation tanks; and sludge-drying beds. Maximum capacity is 3.3 m.g.d.


Anon. "Water and Wastes System for an 'instant factory' " W. Sewage Wks., 111, p. 186-190, 1964. The new textile finishing plant of Pacolet Industries near Blacksburg, S. C., uses water from Buffalo Creek, a tributary of Broad River. A low diversion dam has been built at the intake point and water passes to a 1.5-ml gal. storage tank. Water for emergency supply is stored in an artificial lake, enclosed by an earth dam, which receives storm drainage from the site. Caustic chemicals are recirculated and concentrated before treatment. Industrial and sanitary wastes are treated separately in lagoons and effluent is discharged by a diffusing pipe to Broad River.

Anon. "Water Pollution". Lab. Essais Chambre Comm. Magamet. 2, p. 16-22 1965. (In French) Results are reported from a simple installation of two decanting tanks for treating effluent in a Magamet dewooling plant where water is supplied from a stream that is also the outlet for effluent.

64. Anon. "Water, Waste Water, and Heat in Industry". Ciba Ltd., Basle, Switzerland. 71 pages (In German) A report is given of papers and discussions at a CIBA conference held in Zurich in June, 1961. Subjects dealt with included the collection, composition and treatment of different types of water supply with special reference to the requirements of the textile industry, and the composition and methods of treatment of waste waters from the various processes of the textile industry. The report is illustrated with photographs, plans and diagrams of water supply plant and treatment plant for water waste.


67. Askew, M. W. "Plastics in Waste Treatment". Process Biochem., 1, p. 483-486 and 492, 1966; 2, p. 31-34, 1967. The author discusses the standards for trade effluent imposed and expected in Europe, Canada and U.S.A. As a result of these higher standards new methods of treatment have been devised using polyvinyl chloride corrugated-sheeting units which can be used in place of established biological filtration media, where cost, space and technical problems make the use of activated-sludge tanks and other conventional methods impracticable. The characteristics of Flocor medium and its advantages over conventional filter media are described and examples are given of its use to treat waste waters from distilleries, breweries, fruit and vegetable processing, and textile plants.

68. Aston, R. S. "Zinc Recovery from Viscose Rayon Effluent". Ont. Ind. Waste Conf., Proc. No. 13, p. 215-230, 1966. The recovery of Zn, in the form of ZnSO₄, by ion exchange was successfully applied to the treatment of effluent liquors from a viscose rayon plant. The resin used was Permutit Q, a cation exchanger of the sulfonated polystyrene type, operating in the H cycle and regenerated with H₂SO₄. The process is more effective than an evapn. process in reducing the Zn pollution content, since large vols. contg. a low concn. may be treated. The tech. and economic feasibility is enhanced at plants that produce different types of viscose yarn. At the Cornwall plant of Courtaulds (Canada) Ltd., the Zn discharge to the river was reduced by 80%.
1. Baetsle, R. "Study of Dyeworks Waste Waters". Bull. Mens. Centre Belge et Document., Eaux, (27), p. 16-29, 1955. (In French) Taking two examples of dye works associated with the cotton industry, results are shown in tables of physical and chemical analyses of water supply and waste waters in each case. The effects of discharge of waste waters on the receiving rivers are also illustrated by means of tables and possible methods of treatments are discussed.

2. Ballnus, Willi. "Chemical Purification of Various Industrial Waste Waters". Wasser Luft Betr., 8, p. 201-204, 1964. (In German) Pptn. processes are described for the treatment of waste water from a paper and ceramic-producing industry and a textile plant. Good purification was obtained in the 1st case with Al$_2$(SO$_4$)$_3$ and activated SiO$_2$. Usable results were obtained with Fe$_2$SO$_4$ in combination with Ca(OH)$_2$ and with Al$_2$(SO$_4$)$_3$ in the treatment of textile waste water. A so-called "waste water purification sulfate" gave the same result as Al$_2$(SO$_4$)$_3$ but the usefulness of this product has not been completely tested. Costs of chemicals for the individual pptn. processes are given.


4. Banerji, S. K., B. B. Ewing, R. S. Englebrecht, and R. E. Speece. "Kinetics of Removal of Starch in Activated Sludge Systems". J. Water Pollution Control Fed., 40, (2), Part 1, p. 161-173, 1968. A laboratory-scale study of the kinetics of starch removal in activated sludge systems revealed that first-order kinetics prevail during the initial aeration period, with the removal-rate constant dependent on food-to-microorganism ratio rather than on initial sludge concentration. Removal of total chemical oxygen demand follows zero-order kinetics and depends on initial mixed liquor suspended solids. The effect of temperature on both removal rates is significant. In aerobic systems, further breakdown of starch breakdown products occurs inside microbial cells. Anaerobiosis has no effect on starch degradation under good mixing conditions, but greatly retards total-COD and total-carbohydrate removals. 15 references.

5. Barlow, W. D. "Practical Aspects of the Design of Waste Stabilization Ponds". Proc. 9th sth. munic. industr. Waste Conf., p. 65-74, 1960. Lagoons can be designed to provide complete treatment for any waste water, domestic and/or industrial, provided it contains the necessary nutrients and is free from substances which are toxic to bacteria or algae. The author discusses the basic processes involved; factors affecting the design and operation of the lagoon (particularly
under conditions in North and South Carolina); performance of the lagoon, including methods of measurement; and precautions to be taken to avoid health hazards, pollution and other nuisance problems. In discussion, reference was made to lagoons used for treating mixed waste waters containing 70-80 per cent of textile finishing waste waters and 20-30 per cent of domestic sewage, and especially to the problems encountered which appear to be caused by toxic metals in the waste water.


8. Barnhart, E. L. "Determination of the Degradability of Synthetic Detergents". Wastes Eng., 34, p. 646-648, 1963. Sufficient laboratory tests can be performed to define the degradability of synthetic detergents. These tests may be used to determine the overall effect of the syndets on the treatment plants and the receiving streams. From such studies statistical data can be obtained and interpolation to a wide range of conditions is possible.


11. Beaumont, R. H. "Knit Goods Finishers and Biodegradable Detergents". Knitting Ind., 85, (10), p. 39, 1965. If waste goes through a treatment system, the new detergents are desirable; if not, it may be better to keep biodegradability to a minimum.

benzene, chlorobenzene, toluene, phenol, and cresol, dinitrochloro-benzene, p-nitrophenol and 2,4,5 trichlorophenol are removed. Methods for regenerating the charcoal and separating the contaminants are discussed briefly and the adsorption capacity and required period of contact for each material are quoted, with details of results achieved.

13. Benninga, H. "Biological Oxygen Demand (BOD) of Starch and Starch Derivatives". Tex., 20, (1), p. 25-28, 1961. (In Dutch) It is shown that the BOD of starch products in textile effluents depends to a great extent upon the degree of chemical modification to which the products were subjected. Etherification reduces the BOD of the starch derivatives.

14. Bernhard, P. "Water in Textile Processing". Can. Textile J., 82, p. 45-52, 1965. Water resources, with particular reference to their characteristics and availability for textile processing operations, are discussed under the following headings: Water resources, qualitative requirements, characteristics of various water resources, water impurities, water economy (in textile plants), economic water distribution in textile plants and pollution. 5 references.

15. Biggs, A. I. "Biological Treatment of Textile Effluents". Chem. Ind., 37, p. 1536-1538, 1967. A discussion is given of the treatment of wastes from the textile industry. A large number of factories were located to make use of available water supplies and in many cases are still distant from any large urban conurbation. To offset these difficulties the factories concerned have to undertake the very considerable cost of installing their own biol. treatment plant or become a major contributor to the capital cost of building a new sewage works. In the light of the present knowledge on the economics of biol. treatment the consequences to the textile industry are depressing.


17. Black, Hayse H. and Earl Devendorf. "Industrial Pollution of International Boundary Waters Along the Niagara Frontier". Sewage and Indust. Wastes, 26, p. 1259-1285, 1954. Sources and types of pollution from the areas highly concentrated industries are described in relation to the uses of the boundary waters. Despite tremendous flows in the rivers, there is a marked tendency in the upper Niagara River for sewage and industrial wastes to follow and remain along the shore.


22. Bogatyrev, O., and Rothschein, S. "Toxic Properties of Waste Waters from the Manufacture of Viscose". Chem. Zbl., 129, p. 1183, 1958. The results are given of experiments on the toxicity to fish, other water animals, and bacteria of water containing sulphuric acid, hydrogen sulphide, carbon disulphide, and zinc. It is concluded that to prevent toxic effects of waste waters from the production of viscose fibre, very high dilutions, in most cases higher than are available, are necessary. Even with re-use of water, mechanical and chemical treatment of the waste waters is necessary in many cases.

23. Booman, K. A., J. Dupré, and E. S. Lashan. "Biodegradable Surfactants for the Textile Industry". Am. Dyestuff Rept., 56, (3), p. P82-P88, 1967. Important biodegradability test methods are evaluated and the results obtained in these laboratory tests with various surfactants are reviewed. The degradability of linear alkyl aryl sulphonates has been studied extensively and tests developed. Where data are available field and laboratory results are correlated.

24. Bogren, G. G. "Disposal of Combined Textile Finishing Wastes and Domestic Sewage". Am. Dyestuff Rept., 47, p. P473-P476, 1958. Five years' experience at Sayles Finishing Plants indicates that cotton-finishing wastes having a pH in excess of 10.5 may be treated on trickling filters with a small admixture of domestic sewage, with BOD reductions averaging 50 to 60 per cent. Neutralization of wastes will enable the same trickling filters to reduce BOD 60 to 80 per cent. Mixtures of cotton finishing wastes with a small percentage of domestic sewage show a very small BOD in one day, compared with domestic sewage. 3 references.
25. Borovickova, A., and V. Zahradka. "Methodology of the Orientation Test for the Amenity of Waste Waters to Purification by the Activated-Sludge Process". Sb. Vysoke Skoly Chem-Technol. v Praze, Technol. Vod., 8 (1) p. 393-416, 1964. After a comparative review of methods for assessing the effects of trade waste waters (or their toxic constituents) on the aerobic micro-organisms involved in the treatment of municipal sewage by the activated-sludge process, the authors describe and explain a direct manometric method developed at the Hydraulic Research Institute, Prague, and based on determination of the oxygen demand in the given substrate using an apparatus of the Warburg-respirometer type. The method and formulae used for calculating the results are explained and experiments with synthetic waste waters are reported including graphical results showing the effect of copper and hexavalent chromium on the BOD curve for synthetic municipal sewage and the effects of cyanide on the curve for phenolic waste waters. Further studies were also made with cotton-dyeing waste waters and with a mixture of municipal sewage and spent sulphite liquor. In all cases results were confirmed by tests in a laboratory-scale activated-sludge plant. It was concluded that the manometric method gives reproducible biochemical results and indicates objectively the toxicity of the test material towards the aerobic micro-organisms.


27. Brannock, P. "Water Pollution and Waste Control in the Textile Industry". Textile Forum, 25, p. 10-13 (Dec. 1967-Jan. 1968). The treatment and disposal of textile effluents in North Carolina are briefly surveyed under the following headings: Evaluation of the pollution problem; Sources and types of textile process wastes; Characteristics and effects of pollution; Determination of a course of action; and Reduction of wastes by in-plant process control. 5 references.


29. Brown, J. L., Jr. "Bleachery and Dyehouse Waste Studies". Am. Dyestuff Reprtr., 44, p. P385-P386, 1955. A two-year study of the waste produced in the bleachery and dyehouse has been completed. Pilot plant operation is planned to determine the most economical treatment and design factors for construction purposes. The principles involved, based on analysis of the
lab studies, will be: 1) Segregation of the waste into 3 components; 2) storage of 2 of these components; 3) blending of the 3 components and domestic sewage in proportions that are suitable for biological treatment. The results of the two year study and the theoretical pilot-plant operation are discussed.

30. Brown, John L. "Combined Treatment of Textile Waste and Domestic Sewage". Proc. Southern Munic. Ind. Waste Conf., p. 179-186, 1957. A description of steps taken by Cannon Mills Co. to treat plant waste to comply with state stream pollution laws. Their treatment plant consists of the following units: a storage lagoon for caustic waste, primary settling tanks, two-stage trickling filters, secondary settling tanks, a CI contact tank, and sludge digestors. The combined waste being treated through the plant is about 60% textile waste and 40% domestic sewage.

31. Brown, J. L. "Textile Waste Treatment: What to do About It". Am. Soc. of Mech. Engrs. Paper No. 60-Tex.-2. This paper discusses the textile-waste problem of the author's company and the methods employed to arrive at a solution. A brief description is given of the waste treatment facilities and modifications that have been made in the plant since its completion.

32. Brown, J. L. "Waste Treatment at Cannon Mills". Textile Inds., 124, p. 78-81, 1960. The disposal of domestic sewage from the mills and mill village, as well as certain textile processing wastes from the wet processing plant and slasher rooms, is described.

33. Brown, J. L. "Waste-Treatment Experience Reported". Southern Power and Ind., 79, (1), p. 18-20 and 44, 1961. For treatment of a textile-mill effluent, existing methods were too expensive and didn't solve the problem. The main industrial contaminants were starch and other components from the desizing operation, and a 3% NaOH solution from the cleaning operation. Other plant effluents contributed little to the contamination. A biological purification system was already in use on the domestic sewage from the plant. It was found desirable to take the effluents from the desizing operation and the alkaline liquors separate to the treatment plant. Much of the starch was separated out in the primary clarifier, domestic sewage was treated in a similar unit, and the two effluents were mixed. The wash effluent was stored for a week in large tanks, and then allowed to flow at a regular rate into the domestic sewage so as to give a pH of 11.4. It was not desirable to add this alkaline solution directly into the starch waste, as some of the starch was converted into solvent form. The effluent from the clarifier was then treated in 1st and 2nd stage filters. Separate digesters are provided for the sludge from the primary and secondary filters. Digestion of the primary filter sludge is very rapid owing to the high starch content. This plant removes 96-98% of the settleable solids; the BOD of approximately 1400-1600 was reduced by 81.2% in January and 98.3% in August.


36. Bubnoba, E. A. "Size Substitutes". Tekstil. Prom., 15, (12), p. 49-50, 1955. CMC, Na alginate, pectin, and hide glue (I) can be considered as substitutes for starch in sizing. The dissolving time of I is six times shorter than that of gelatins in preparation of sizing; a size containing I 4.5, 40% soap 8 and glycerol 5% yield yarn of the same quality as in the case of gelatin size.


40. Buswell, A. M. and Mueller, H. F. "Treatment of Wool Wastes". Proc. 11th Industr. Waste Conf., Purdue Univ., Eng. Extn. Ser. No. 91, p. 160-165, 1956. In the scouring of raw wool with soap and alkali to remove foreign matter, the waste waters have an extremely high BOD and are very polluting. The usual method of treatment involves addition of H₂SO₄ and sedimentation to remove grease and sludge, but the sedimentation tank effluent still requires dilution before discharge to the sewers. Wool grease consists of the suint and fat (largely lanolin). Experiments were carried out with unprocessed wool and local sewage and the results showed many advantages.

1. Carrigue, Carlos S., and Luis U. Jauregui. "Sodium Hydroxide Recovery in the Textile Industry". Purdue Univ., Eng. Bull., Ext. Ser. No. 121, p. 861-868, 1966. The NaOH recovery comprises a holding tank with perforated-pipe aerators connected to an air compressor which allows the mixing and equalization of the waste in quantity varying between 60 to 120m³/hr. with an average of 100m³/hr. and also reducing very effectively the high variation that the raw flow has in color, therefore making this treatment easier. The alum dosifiers are of the dry volumetric type. The waste equalization in the holding tank permits the influent to the treatment to keep an adequate alkali so as not to require pre-alkalinization. The sludge sep'd in the settling tank is drawn by gravity to drying beds, the drain system of which returns the unfiltered liquids into the holding tank. Industrial wastes in the Castelar Textile Mill are discharged through a collecting system completely sep'd from the sewage and storm collector drains. The industrial system collects the wastes of all the wetted processes of the mill. The requirements for discharge into storm drains are given.

2. Cerney, A. "Waste Waters of the Textile Industry". Verlag f. Technik und Kultur, Berlin-Charlottenburg, 10 pages, 1956. The preparation of natural and artificial fibers, the waste waters produced, and their treatment are described. The effect of local conditions on the type of treatment are described. The effect of local conditions on the type of treatment plant required, and the necessity for retention tanks and controlled discharge are explained. At a weaving plant, waste waters were settled, mixed, and stored for regulated discharge over 24 hours; when the stream was low waste waters containing sodium sulfite were treated with ferrous sulfate for removal of sulfur; exceptionally dark dye baths were coagulated with aluminum sulfate. At a cotton weaving and dyeing plant using a ground water supply, mercerizing waste waters were treated by sedimentation and filtration and discharged to a seepage shaft 120 m. from the well.

3. Cerney, A. "Waste Waters of the Textile Industry". Lit. Ber. Wass. Abwass., Luft u. Boden, 7, p. 219-220, 1958. The preparation of natural and artificial fibers, the waste waters produced, and their treatment are described. The effect of local conditions on the type of treatment plant required, and the necessity for retention tanks and controlled discharge are explained. At a weaving mill with dye works and finishing plant, waste waters were settled, mixed, and stored for regulated discharge over 24 hrs; when the stream was low waste waters containing Na₂S were treated with FeSO₄ for removal of S; exceptionally dark dye baths were coagulated with Al₂(SO₄)₃. At a cotton weaving and dyeing plant using a ground-water supply, mercerizing waste waters were treated by sedimentation and filtration and discharged to a seepage shaft 120 m. from the well. Phenolic tastes were caused in the water by a precipitation used for mercerizing and persisted for almost a year after use of the precipitation had been stopped.


7. Chipperfield, P. N. J. "Performance of Plastic Filter Media in Industrial and Domestic Waste Treatment". J. Water Pollution Control Fed., 39, p. 1860-1874, 1967. In Great Britain, a plastic medium for packing trickling filters has been developed and tested with domestic and industrial wastes, including textile dyeing and finishing wastes. The medium (Flocor), consisting of alternate plain and corrugated sheets of polyvinyl chloride, is said to be inexpensive and efficient.


12. Cook, L. B. "Textile Wastes". Proc. 15th Ann. Water Conf. Engrs. Soc. West Pa., p. 49-51, 1954. An outline is given of the processes carried out in cotton-finishing plants and of the characteristics and volume of waste water produced. Practices which would lead to the reduction in volume of wastes and in their polluting nature are described. These include the installation of steel equipment and the use of hot water for bleaching processes in place of wooden wash-boxes and large volumes of cold water; the use of control valves to shut off water supplies when cloth travel is stopped; reduction of the BOD load of waste waters by the substitution of synthetic detergents for soaps or mineral acids or acid salts for acetic acid, and of CMC for starch; elimination of toxic chromium from the wastes by the use of agents other than sodium chromate for oxidizing vat dyes; the recovery of caustic soda used in the mercerizing process where practicable; and the segregation of the more highly polluting waste waters from those which can be discharged to a stream without treatment. A method for the treatment of cotton-finishing waste waters is outlined which consists of storage in a lagoon or retention tank for the purpose of balancing the wastes and ageing during which period a reduction in the BOD frequently occurs, followed by coagulation and sedimentation. Application of the settled effluent, fortified by N and P, to percolating filters, has proved satisfactory on a pilot scale to effect a further reduction in BOD where primary treatment has not yielded an effluent suitable for discharge to surface waters.

13. Cook, N. E. "The Prevention of Water Pollution with Special Reference to Some Aspects of the Textile Industry". Can. Textile J., 81, p. 39-44, 1964. The following are discussed: water purity standards, the nature of water-borne waste from a textile mill, methods of rendering these water wastes innocuous, control measures to prevent pollution, and pollution control measures at a polyester fiber producing plant. 11 references.

14. Culver, R. H. "Pilot-Plant Treatment in Sewage-Textile Waste Mixtures". J. Boston Soc. Civil Engrs., 43, p. 227-248, 1958. The North Buffalo sewage works of Greensboro, N. C., was designed as a conventional activated-sludge plant to treat 6.5 m.g.d. of mixed sewage and textile waste waters; chemical coagulating was also provided. As a result of a gradual increase in the volume of the textile waste waters, the plant became overloaded and since 1941 has operated as a chemical precipitation plant only. The total volume received at the plant is about 11 m.g.d., of which about 40 per cent is textile waste. Before designing a new treatment plant, pilot-plant studies were carried out on treatment of the mixed sewage and waste waters by various biological methods; some of the results of those experiments are described. It was concluded than an effluent with a BOD of about 50 mg/l. could be obtained by two-stage biological treatment if the pH value of the influent was reduced to less than 9.5; this can
be achieved satisfactorily by treatment with flue gas. First-stage biological treatment on a percolating filter operating with recirculation stabilizes the system and prevents shock loads affecting the subsequent activated-sludge process. The suspended solids in the mixed liquor from the activated-sludge units settle only slowly and coagulation before final sedimentation is necessary to give a well-clarified effluent. About 80 per cent of the indigo dye in the waste waters is adsorbed on the biological flocs during treatment. The amount of sludge produced is too small to be used as a source of gas for power production, and it is suggested that the process be operated so as to produce a minimum quantity of sludge and thus reduce sludge handling.
1. David, J. and P. Roy, "Some Measurements of Toxicity of Tannery and Textile Wastes and Their Components to Fish by Bio-Assays". Indian J. Fish., 7, p. 423-442, 1960. During a study of pollution in the river Ganga at Kanpur, the toxicity of various tannery and textile waste waters were investigated by bio-assay techniques, using minor carp and cat fish as the test fish. Results are tabulated showing the physical and chemical characteristics of the individual waste waters (..., and three textile waste waters, namely kier, dye, and bleach liquors) and the percentage of survival and median tolerance limits for the test fish at different concentrations of waste waters. The observed behavior of the fish is also summarized. The results are analyzed statistically and discussed in relation to the composition of the waste waters. It is concluded that ... kier liquor is harmless above 19-25 times dilution and dye liquor is less harmless than kier liquor; but bleach liquor is very toxic owing to the presence of chlorine and was the only liquor which in minute concentration proved fatal to fish.

2. Dean, B. T. "The Design and Operation of a Deep-Well Disposal System (For Nylon Manufacturing Wastes)". J. Water Pollution Control Fed., 37, (2), p. 245-254, 1965. A report of the operation of a deep injection well for the disposal of aqueous process wastes from nylon manufacture is given. Reasons for the choice of this disposal method are discussed and details of the preliminary geological survey are given. The method is described as extremely satisfactory because of its simplicity, finality, and economy.

3. Deighton, K. A. "The Treatment of Kier Liquor in Admixture With Sewage". Water Pollution Control, 66, (5), p. 484-491, 1967. It has been established that Greenfield (Lancaster-shire) sewage containing kier liquor and other trade effluents can be successfully purified by two-stage treatment using a partial-treatment activated-sludge plant followed by biological filtration. While no set of conditions ensured a 30:20 effluent at all times, departures from this were generally slight. On average, during the later stage of the experiment, effluents were within the 30:20 standard.

4. Demina, A. T. and T. R. Shmul'yan. "Simultaneous Purification of Waste Water from Wool Washing and Municipal Sewage". Ochistka Prom. Stochnykh Vod, ... Gidrogeol., Sbornik, (2), p. 22-44, 1959. Sewage from washing thin and semi-thin wool contains about 140 kg. of fat, and shows a 180-240 kg. five-day BOD. The content of sewage from 200-250 kg. wool in 1000 cu. m/sq.m./hr. The amount of sewage from wool washing added to municipal sewers is controlled according to BOD/max. 500 mg/l. The fat content is more significant, and 120 mg./e may render purification difficult.

5. Dickerson, B. W. "A Solution of the Cotton Sizing Wastes Problem". Industry. Wastes, 1, p. 10-18, 1955. The BOD loads from cotton dyeing and finishing plants vary from 3000 to 30,000 lb/day
and waste flows range from 2 mgd to 15 mgd, depending upon the mill's size. The major source of BOD from the plant comes from corn starch used in cotton's processing, and later washed away with hot water. This waste water may be treated either by chemical precipitation or by biological oxidation using a combination of percolating filters and activated sludge. Studies were made on methods of reducing the strength of the desizing waste waters, by using a compound with a low BOD in place of starch. Experiments were made to determine comparable strengths of starch and CMC. It was found that CMC had a five-day BOD value of 11, whilst the five-day BOD of starch was 812. Also, the CMC doesn't require an enzyme for desizing and needs only 1/2 of the wash water. Studies were made at a mill to check on the lab results. Pilot-plant studies were made using percolating filters one unit being fed a mixture of sewage, one a mixture of CMC in sewage, and one a mixture of starch in sewage. As a result of these studies, it has been found that the use of a mixture with 65% starch and 35% CMC in place of starch alone, although being costly in the first instance, gives an appreciable decrease in cost of waste water treatment, while the cotton produced by this method is equal to or better than the previous product. Where over-all reductions of BOD value of 30-40% are required, the use of the starch-CMC mixture may result in the elimination of any treatment plant.

6. Dickerson, B. W. "Unique Treatment System for Chemical Cotton Wastes". Proc. Ind. Water Waste Conf., 5th, Dallas, p. 397-427, 1965. Three methods of handling wastes from the processing of cotton linters have been investigated: evaporation, burning, and recaustization for recovery of caustic soda; the Zimmermann process; and biological oxidation. The last method appeared to be the most feasible and details of its development through semi- and full pilot-plant stages to the design of full-scale plant are given.

7. Dietrich, K. R. "Simplified Chemical Treatment of Waste Water From Textile Factories with Clarifying, Flocculating, and Precipitating Agents". Text.-Prax., 22, (2), p. 126-127, 1967. (In German) Mixtures of electrolytes containing Al3+, Fe3+, Fe2+, Si4+, and Ca2+ are more effective flocculating agents than those containing only Fe3+ cations. Applied to textile plant sewage at <50 mg./l., the mixtures drastically reduce the organic matter, ppt. or absorb dyes and P compounds, and improve the drying of the sludge; the effects are largely independent of pH. Thus, in 1 case, the treatment reduced the B.O.D. from 215 to 25 mg. O/1. and the KMnO4 consumption from 1005 to 320 mg./l., while the pH changed from 7.5 to 6.8 and the settling solids from 20 to 175 mg./l. This obviates further pH adjustment, rock filtration, or ion exchange treatment.

8. Divet, L. "Treatment of Waste Waters". Rev. Text.-Tiba, 55, (N.S.) p. 25-29, 1956. Waste waters from bleaching and dyeing, kept separate from unpolluted waste waters, are mixed, aerated, treated with lime, ferrous sulfate, and sulfuric acid, flocculated by stirring, and settled. The BOD is reduced by 75% and the effluent is colorless.
9. Downing, A. L. and L. J. Scragg. "The Effect of Synthetic Detergents on the Rate of Aeration in Diffused-Air Activated-Sludge Plants". Wat. Waste Treat. J., 7, p. 102-107, 1958. The absorption coefficient and performance of a laboratory scale continuous flow diffused air activated sludge plant were studied in the presence and absence of detergents when oxygen supply was plentiful and when it was deficient. Synthetic sewage was emphasized to which 10 ppm of anionic surface active agent was added.

1. Block, C. R. "Inorganic Effluents - A Case History". *Effl. and Wat. Treat. J.*, 5, (6), p. 314-318, 1965. This article describes the investigation and design and method of treatment of the effluent problem a manufacturer of motor accessories was faced with. The re-arrangement of the existing drainage system, bringing the effluent to a standard suitable for re-use, is described prior to the treatment of wastes.


4. Evers, D. "Carpet Manufacturing Effluents and Their Treatment". *J. Proc. Inst. Sew. Purif.*, Part 5, p. 464-470, 1966. Carpet processing effluent is divided into categories - effluent from (1) scouring of raw wool and yarn, (2) dyeing, (3) sizing, (4) latexing, (5) moth- and mildew-proofing. If a firm discharges all these effluents, the smaller volumes of effluent from latexing and proofing will be lost in the larger volumes from scouring and dyeing. If only dyeing and latexing are carried out, acid dye liquors will precipitate latex and clog the sewers. Acidity in dye liquor could be used to reduce the acid needed in treatment of fatty scouring effluent, but the increased volume of liquor to be treated would be uneconomic to process as scouring liquor. The scouring liquors have a high biological oxygen demand; dyeing liquors can be put to better use as diluents for the outflow from the grease cracking plant.

1. Fearn, R. J., W. H. Hetherington, S. M. Jaeckel and C. D. Ward. "A Reduced-Scale Method for the Determination of the Dichromate Value (Chemical Oxygen Demand) of Sewage and Trade Effluents". J. Soc. Dyers Colourists, 83, p. 146-151, 1967. A description is given of a convenient and reliable analytical method for the determination of the dichromate value of sewage and trade effluents. The method is more rapid than existing macro-scale procedures and is sufficiently analytically accurate and reproducible for the calculation of trade-waste treatment charges. Oxidation with potassium dichromate is carried out in boiling 50% (vol./vol.) sulfuric acid, with a total reagent volume of 30 ml. 8 references.

2. Felstead, J. E. "Biological Treatment Solves Dyeworks Effluent Problems". Wat. Waste Treat. J., 11, p. 127-129, 1966. A description is given of the development of treatment facilities for waste waters from the textile dyeing and finishing plant of Joshua Wardle Ltd. at Leek, Staffs., which involved preliminary chemical analyses of a considerable number of minor effluents and laboratory-scale trials on composite effluents. The waste waters were formerly passed over alumina ferric blocks and settled before discharge, but the effluent failed to comply with the standards laid down by the Trent River Authority. The waste waters from the 2 mills, in nature mainly organic, but also containing low concentrations of a variety of other compounds such as inorganic salts and bases, are now pumped first to a holding tank, and then to 2 activated-sludge tanks fitted with Simcar aerators. After secondary sedimentation, the final effluent is discharged to the river Churnett, a tributary of the river Dove.


removal is necessary; if the latter is not required a soda method is recommended and regeneration of the Zn is not expedient. In the soda-sulfate method a Na₂CO₃ soln. is added to the waste waters to pH 4-4.5; after blowing with CO₂ in a degasifier the pH is brought to 8.5-9.5. The Zn₃CO₃(OH)₄ formed is pptd. in vertical settling tanks. Then the waste waters are subjected to final Zn removal with Na₂S followed by filtration on sand filters (filtration rate 5 m./hr.). The ppt. is dehydrated on vacuum filters and dissolved in a soln. of a pptg. bath. The regeneration soln. is freed of mech. impurities and returned to the production line. To reduce the reagent consumption the waste water should be alk.

6. Fong, W. "Treatment of Wool Scouring Wastes with Colloidal Bentonite". Textile Research J., 25, p. 994-1000, 1955. After cooling and acidification of waste waters from wool scouring, the addition of 0.1-0.5% bentonite gives a bulky ppt, easily removed by filtration and centrifuging, leaving a clear light-yellow effluent. If the waste waters are not cooled before coagulation, more bentonite is required but the resulting sludge is more compact. Under optimum conditions the concentration of grease and the COD of the waste waters were reduced by 96% and 60% respectively, compared with reductions of 67% and 33% for acidification alone.

7. Franklin, J. S., E. Bowes, and J. F. Colville. "Calcium Chloride in Processing of Woolen Yarn Works Wastes". Chem. Trade J., 154, p. 78-79, 1964. A review of the results of two year's operation of the waste treatment plant installed by Patons and Baldwins Ltd. at Darlington for recovery of grease by treatment with calcium chloride. The plant has been slightly modified since it was first put in operation. The mixed waste waters are first screened to remove wool fibers and treated in a hydrocyclone to remove most of the suspended solids. They are then centrifuged to recover neutral wool grease before cracking with CaCl₂ and filtration. The cost of the precoating material for the vacuum filters has been reduced by blending suitably graded wood flour with expanded perlite. Direct application of the CaCl₂ to the filter bowls has been successful in preventing the slow after precipitation of calcium chloride which had been causing difficulties in the filters.

1. Ganapati, S. V. "In-Plant Process Control for Abatement of Pollution Load of Textile Wastes". *Environ. Health (India)*, 8, (3), p. 169-173, 1966. (In English) The redn. of waste production procedures at a textile mill is discussed. It is possible to reduce the vol. and strength of the waste by recovery of certain salvageable substances. It is also possible to recover much waste heat during the processes. A significant quantity of pollution results from the waste of the sizing process. This can be reduced by utilizing chemicals with a lower BOD, such as synthetic sizing agents which produce wastes with a much lower BOD than those from natural sizing agents.

2. Gantsmakher, Z. "Composition and Clarification of Waste Waters From a Synthetic Fiber Factory". *Dokl. Neftekhim. Sekts., Bashkir, Respub. Pravl. Vses. Khim. Obshchest.*, 2, p. 143-145, 1966. (In Russian) Industrial waste waters from the Chernigovskii factory are fed to an aeration station for clarification of urban sewage. Before discharging into the river the clarified waste waters pass through 2-step biol. ponds. The indexes of waste waters discharged from the clarifying equipment and of the river water 1 km. below the discharge point are: BOD 4.12, 6.03; oxidizability 9.4, 8.24; caprolactam concn. 0.9, 0.16; dissolved O 11.39, 7.37 mg./l., resp.

3. Garda, C. "Use of Sulphite Waste Lye in the Dyeing of Viscose in the Mass with Sulphur Dyes". *Przegl. Papiern.*, 13, p. 219-220, 1957. After an explanation of the dyeing process with vat dyes, a process is described in which sulphite waste lye, containing 6 per cent sulphur dioxide and with a pH value of 2, is used in combination with soda for preparation of the leuco compounds.


   *Teinture et Apprets.*, p. 181-188, 1962. (In French) This 
   is a review of the material to be found in effluent from 
   dye works, and mechanical and chemical methods of treatment.

8. Griffe, M. "The Effluent Waters from Dyeing and Finishing". 
   code of legislation concerning the disposal of effluent by 
   three methods (a public sewage works, septic tanks, or by 
   spreading over the ground) has been developed after many years 
   of experience.

   (In German) The required purity levels and test methods are 
   summarized. Corrective measures and normal volume require-
   ments in finishing are specified.

10. Gurnham, C. F. "Disposal Control of Water Pollution". *Chem. 
    program for prevention of water pollution; origins of 
    pollution; wastes from industry; disposal of industrial wastes; 
    significance of stream pollution; significance of sewer 
    pollution; recovery of reuse of material; spillage and 
    cleaning problems; blending vs. segregation; physical, chemical 
    and biological treatment; survey of plant; problems of con-
    tinuity; trends in pollution control.
1. Haake, G. "Electrolytic Removal of Copper from Wash Waters from the Production of Rayon by the Cuprammonium Process". Neue Huette, 11, (5), p. 272-278, 1966. (In German) Effects of copper concentration, sulphuric acid concentration, and temperature have been investigated.


4. Hann, R. W. Jr., and F. D. Callcott. "A Comprehensive Survey of Industrial Waste Pollution in South Carolina". Industrial Waste Conf. (Purdue), 20, p. 538-550, 1965. This study discusses the major industries (the textile industry is the largest) using the waters of South Carolina. Their processes are examined and the location and magnitude of their waste discharges noted. The scope of the various industries in relationship to their waste discharges as compared to one another and to the domestic population is calculated. 7 references.


6. Harsveldt, A. "Industrial Applications of Starches in the Paper and Textile Industry". Chem. and Ind., (51), p. 2062-2070, 1961. The author describes the uses of various forms of starch in the paper and textile industries. The use of hydroxyethyl and hydroxypropyl ethers of starch lowers the BOD of the resulting waste waters, the reduction in BOD being greater the higher the degree of substitution of the starch product. A reduction in BOD of 70% could be obtained by a degree of substitution of 0.1.

7. Hart, W. B. "Cotton-Bleaching and -Dyeing Wastes - A Specific Solution and a General Prescription". Ind. Eng. Chem., 49, (3), p. 81-82, 1957. The characteristics of waste waters from bleaching and dyeing of cotton that require correction are high alkalinity, suspended matter, color, and BOD. The pH value of the bleaching waste water is first adjusted with flue gas, which has previously been cleaned in a water scrubber tower. The waste water is then treated in an upward-flown sedimentation tank before filtration through a two-stage percolating filter with recirculation of effluent. Waste waters from the cleaning and decoloring of foreign cotton goods by kiering with sodium peroxide are highly colored and strongly alkaline; these waste waters can be decolorized with Cl₂ before mixing with other bleaching wastes. Waste waters from the kiering of cotton to remove oil and grease are strongly alkaline, contain suspended matter, are red-brown in color, and have a

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8. Hart, W. B. "Cotton-Bleaching and -Dyeing Wastes - A Specific Solution and a General Prescription". Ind. Eng. Chem., 49, (3), p. 81-82, 1957. The characteristics of waste waters from bleaching and dyeing of cotton that require correction are high alkalinity, suspended matter, color, and BOD. The pH value of the bleaching waste water is first adjusted with flue gas, which has previously been cleaned in a water scrubber tower. The waste water is then treated in an upward-flown sedimentation tank before filtration through a two-stage percolating filter with recirculation of effluent. Waste waters from the cleaning and decoloring of foreign cotton goods by kiering with sodium peroxide are highly colored and strongly alkaline; these waste waters can be decolorized with Cl₂ before mixing with other bleaching wastes. Waste waters from the kiering of cotton to remove oil and grease are strongly alkaline, contain suspended matter, are red-brown in color, and have a
high BOD. One method of treatment of these waste waters involves adjustments of the pH value to 6.0-6.5 with a cheap acid, aeration, upward-flow sedimentation, and flow across a gently sloping soil treatment bed to reduce the BOD. NaOH can be recovered economically from mercerizing waste waters by dialysis; when the volume of waste is large, it should first be concentrated. Waste waters from the dyeing process may contain suspended dye matter or true color. They can be treated by chemical coagulation, upward-flow sedimentation, and biological filtration.


11. Hazen, Richard. "The Treatment of Textile Wastes and Domestic Sewage". Proc. Southern Munic. Ind. Waste Conf., p. 161-178, 1957. A description of pilot-plant studies at the North Buffalo Creek, Greensboro, N. C., sewage treatment plant to determine the applicability of available methods to the waste from this plant, allowable loadings for plant design, effect of toxic dye wastes on treatment processes, the need for nutrition above that provided by sewage to maintain biological activity, and the relative cost of providing combined treatment as compared with the treatment of sewage alone.

12. Herla, W. "Dyehouse Effluents". Textil-Praxis, 14, (5), p. 509-510, 1959. (In German) A precipitation process is described in which the dyehouse effluents are purified and neutralized so as to eliminate contamination of river waters.

13. Hess, F. E. "Treatment of Waste Waters of the Textile Works Hermann Windel G.M.B.H. in Windelsbleiche near Bielefeld". Wass. u. Bochden, 9, p. 474-475, 1957. As the dilution available for the waste waters of a textile factory at Windelsbleiche is small, the waste waters are treated by irrigation and as artificial rain after sedimentation for 8-10 hours. The area used for disposal is drained and the drains discharge into a pond with a retention time of about 3 days from which the effluent flows to the stream. Baffles and
cascades at the inlet and outlet of the pond ensure intensive aeration. Efforts are being made to reduce the load on the land and improve results by separate preliminary treatment of waste waters from different processes.


22. Heukelekian, H. "The BOD Test in Textile Mill Waste Problems". Textile Inds., 121, (7), p. 74-77, 1957. The author describes the BOD test and its applications and limitations, with particular reference to its use for the analysis of waste waters from textile mills. It is pointed out that the test is a measure of the amount of oxidizable material, without interference from extraneous inhibiting influences.


24. Hill, D. W. "Disposal of Effluent". Textile Weekly, 65, (2), p. 841-842, 1965. The activated sludge method of biological treatment of disposing of dyeing and finishing wastes, as applied by the Shirley Institute, is outlined. Mention is also made of the use of water-conserving washing procedures to reduce both the amount of water used and the volume of effluent.

25. Hilliard, A. "Recovery of Heat from Effluent". Rayonne et Fibres Synthet., 20, (12), p. 1127-1138, 1964. (In French) The polybloc heat exchanger units are shown to be suitable for effluent liquors. The units are build up from perforated cylindrical metal discs, with polytetrafluoroethylene or graphite seals. Heat recovery units which embody this Polybloc exchanger are described with diagrams: one installation, in which heat from hot washing liquor effluent is used to preheat the bleaching bath in a viscose spinning plant, is described in particular detail.

bio-resistance of straight- and branched-chain alkyl phenol nonionic structures. Although biodegradable detergents by their very nature must have a biological oxygen demand (BOD), studies indicated that BOD values required by primary straight-chain alcohol nonionic products should not noticeably affect total BOD requirements of textile plant effluent waters.


30. Hutto, George A., Jr., and Samuel W. Williams, Jr. "Pilot-Plant Studies of Processing Wastes of Cotton Textiles". Proc. Southern Munic. Ind. Waste Conf., p. 31-43, 1960. At the Mooresville Mills, Mooresville, N. C., pilot plant studies were run to study the problem of stream pollution by developing special waste-treatment methods standardized against the particular situation in large cotton textile manufacturing. It was desired to reduce both the volume and pollutional load of the waste and to make it more susceptible to biological purification. To reduce BOD, pH, alkyl and the like, a pilot plant system was equipped with lagoons, aeration, chemical preparation, and trickling filters. During manufacture, in-plant changes were made to prepare for the reduction of the pollution load of the waste, e.g., by substituting CMC for starch sizes in the mill operation, detergents for soap in the cleaning and dyeing operations, and similar changes in regard to certain dyes and finishing agents whenever practicable. The most important part of these preparations in the future will be a caustic recovery unit reducing alkyl of mercerizer waste. Experiments proved the cost of chemical treatment was too high when compared with biological methods. Results of the studies proved that the cost of full-scale industrial waste treatment was cut to less than one-fourth of the previous estimates.

encountered problems. Possible solutions are suggested and recommendations regarding research needs are made. An additional list of possible research projects, suggested by industry representatives, is included in the report. Many of these are concerned with the development of more efficient processing equipment and management techniques.

32. Hynes, H. B. N. "The Biology of Polluted Waters". Liverpool Univ. Press, 123 Grove Street, Liverpool 7. 202 pages, 1963. A general outline of the biology of unpolluted inland waters is followed by a general account of the various types of effluents and their chemical and physical effects upon streams. Biological results of pollution is described and future prospects are considered.
1. Iida, H., and N. Kuwahara. "Basic Studies on the Clarification of Waste Water Containing Dyes. I. Precipitation of Direct Dyes by Ferric Chloride". Rep. Govt. Chem. Ind. Research Inst., Tokyo, 58, (3), p. 137-144, 1963. (English summary) In studies on the hetero fluctuation of 5 direct dyes by ferric chloride from aqueous solutions, the precipitates were removed by centrifuging and the amount of unprecipitated dye was estimated colorimetrically. Precipitation was increased when the pH value was less than 5, and 95-100% of the dye was precipitated from a solution with 10 parts per million at pH 5 by the addition of 60-100 parts per million ferric chloride. Precipitation varied with the dye; some dyes precipitated in amounts less than 30% and others precipitated completely under the same conditions. With some dyes, precipitation was reduced by addition of sodium sulfate.

2. Iida, H., and M. Endo. "Precipitation of Direct Dyes and Acid Dyes by Iron Salts". Kogyo Kagaku Zasshi, 70, p. 403-404, 1967. In order to obtain basic data for the clarification of industrial waste water containing dye, 18 direct dyes and six acid dyes were precipitated from each aqueous solution by the addition of ferric chloride or ferrous sulfate, and the amounts of precipitated dyes were determined. From the results it was found that ferric chloride and ferrous sulfate were excellent for the precipitation of direct dye, but were not useful for acid dye. It was difficult to precipitate acid dyes from their aqueous solution containing sodium sulfate by the above method. 4 references.

3. Iida, H. and others. "Precipitation of Direct Dye by Ferrous Sulfate". Kogyo Kagaku Zasshi, 67, p. 210-213, 1964. (English summary) In order to obtain basic data for the clarification of waste water containing dyes, experiments on the precipitation of five direct dyes in aqueous solution were carried out by the addition of ferrous sulfate. The purified dye was dissolved in water and ferrous sulfate solution was added to the solution under various conditions. The precipitate formed was separated by centrifugation and the remaining dye in the filtrate was determined by colorimetry.

4. Ingols, R. S. "Manganese in Process Water of the Textile Industry". Tribune CEBEDEAU, 20, p. 271-272, 1966. (In French) Hazards arising in textile plant from the presence, usually seasonal, of manganese in surface water used as a water supply, are discussed. Accumulated deposits of manganese oxides in heat exchangers and distribution systems can be released by pressure surges and result in staining of white cloth and in shade changes in some dyes. Five methods of treating the water supply are suggested.

5. Ingols, Robert S. "Textile Waste Problems". Sewage and Ind. Wastes, 30, p. 1273-1277, 1958. Starch, textile fibers, sulfides, and dyes are components of the wastes which should be reduced by biological treatment. High pH values, high
Salt concentrations, mildew depressants, chromates, bleach solutions, and synthetic detergents are components which may interfere with biological treatment. Through design, it is possible to provide treatment of textile wastes by lagooning, trickling filters, or activated sludge.


7. Isaac, Peter C. G. "Principles of Waste-Water Treatment". *Effluent and Water Treat. J.*, 3, p. 480, 1963. This material is divided into the following eight parts: Disposal of liquid wastes, Waste characteristics, Legal control of liquid wastes, Treatment of liquid wastes, Preliminary and primary treatment, Biological treatment, Treatment and disposal of sludge, Sludge drying.
1. James, G. V. "Water Treatment. A Guide to the Treatment of Water and Effluents Purification". The Technical Press Ltd., London, 3rd edition, 320 pages, 1 plate, 1965. 63s. This is the third, revised and enlarged edition of a book first published in 1940 and revised in 1949 and dealing with the treatment of water for domestic and industrial use, the treatment of trade effluents, and the treatment of sewage. Chapters are included on various processes of water treatment; types and effects of pollution caused by industrial waste waters; treatment of waste waters from specific industries; treatment of water supplies for specific industries; design of municipal sewerage systems; and various methods of sewage treatment. Relative references are appended to each chapter, and author and subject indexes are included.


3. Jenkins, S. H., and others. "Some Analytical Methods Used in the Examination of Sewage and Trade Wastes". J. Inst. Sewage Purif., Part 6, p. 533-565, 1965. The methods reviewed are divided into six sections as follows: suspended solids; chemical oxygen demand or dichromate value; organic carbon; extraction and fractionation of oils and greases; preparation of samples for metal analysis and sorting tests for metals and cyanide; extraction apparatus for metals, etc., and zinc determination by dithizionate.


5. Jones, E. L., T. A. Alspaugh and H. B. Stokes. "Aerobic Treatment of Textile Mill Waste". J. Water Pollution Control Fed., 34, p. 495-512, 1962. This paper reports on a full-scale, single-stage modification of the conventional activated sludge process to the contact stabilization process. The results of further pilot-plant studies on the biological treatment of textile waste waters in admixture with sewage at Greensboro, N. C., are given and discussed. Two modifications of the activated sludge process were investigated, namely contact stabilization and prolonged aerobic stabilization. The contact stabilization was found to give good results with mixtures in which about half the BOD load was contributed by textile wastes and reductions in BOD of 85-90% were obtained without chlorination; good color removals were also obtained.

production, treatment, and disposal. It covers the period from 1950 to 1966. Thus, it complements two similar surveys which cover the literature published prior to 1950. Processes related to the manufacture of cotton, wool, silk, flax, and man-made fiber products are discussed. Problems such as excessive color in plant effluents, the effects of synthetic detergents on waste treatment, and waste-heat recovery are highlighted. Special emphasis is placed on problems which are in need of accelerated research effort.


8. Jones, L. L., Jr. "Textile Waste Treatment at Canton Cotton Mills". J. Water Pollution Control Fed., 37, (12), p. 1693-1695, 1965. Canton Cotton Mills began to check into the problem of treating textile wastes about 1958. All waste was turned into the same effluent pipes and for 1.5 years tests were conducted on the combined wastes for B.O.D., pH, dissolved O, color, solids, and percent removals due to treatment. The quality of air and plant size were calculated on the basis of volume of waste and all the factors involved. Several methods were examined, but it was concluded that a prolonged biol. aeration process appeared to give the best results. Construction of a plant for waste treatment was decided, and the plant was completed in November, 1960. The process is called a biol. waste tank process. Sixteen to 72 hours aeration are required to complete oxidation. Details of the process are given.


3. Kaeding, J. "The Purification of Waste Water in the Production of Polyamide-Fiber". Fortschr. Wasserchem. Ihrer Grenzgeb., 5, p. 258-283, 1967. (In German) Water from the production of polyamide fibers by the steeping and direct spinning processes was contaminated with org. substances, such as ε-aminocaprolactam oligomers, products, and detergents. Further knowledge concerning the amt. (55-7 m.3/ton) and kinds of impurities and how they can be treated was sought. Waste water purification by the activated sludge process was studied. Lab. scale tests were carried out on a 2-stage biol. treatment followed by flocculation. The purification depended on the conc. of the influx and on the load. The conversion rate increased with the influx concn. with optimum process control. Holding times of 6-8 hrs. sufficed for the decompn., which was effected with more certainty and greater capacity at 30° than at 20°. The water contg. only lactam was more readily purified than the waste water from Dederon (GDR polyamide fiber) production. The lactam N was consumed by the microorganisms, so that only phosphates had to be added for microbial decompn. Substances not easily biodegradable were removed from the waste water by adsorption with coagulants (Al2(SO4)3.18H2O; FeCl3.6H2O; FeSO4.7H2O; CaO) and the decompn. capacity was then approx. that of lactam-contg. water. A treatment with coagulants after the biol. purification removed nondegraded products and nonsedimented biomass formed with large loads in the biol. stage. 13 references.

4. Kashiwaya, M. "Activated-Sludge Treatment of Textile and Dyeing Mills Waste". Proc. 2nd Intern. Conf. Water Pollution Research, Tokyo, 2, p. 63-84, 1965. In the region of Ichinomiya, Besai, and Kisogawa, Aichi Prefecture, Japan, waste waters from 129 factories processing, dyeing, and finishing textiles have caused serious pollution of the Nikko River and many irrigation channels. After discussing the sources and characteristics of these waste waters, the author reports pilot-scale studies, with tabulated and graphical results, which showed that the waste waters could be treated effectively by a conventional activated-sludge or contact-stabilization process.


7. Kehr, D., and P. Pflanz. "The Sewage-Treatment Plant at Nordhorn". Gas- u. WassFach., 107, p. 260-266, 1966. An illustrated account is given of the design and operation of the activated-sludge plant at Nordhorn, Germany, designed for treatment of both sewage and textile industry waste waters. Extensive pilot-plant experiments carried out to prevent putrescible matter from inhibiting sludge digestion led to replacement of the anaerobic sludge digestion unit by a specially developed aerobic sludge-stabilization plant which is odourless, is less costly, and has proved most successful. Results showed removal of 70 per cent of the permanganate demand and 93.5 per cent of the 5-day BOD, leaving the effluent free from solids and reducing its turbidity.

8. Kehren, M. "Effluent-Water Problems in the Textile Finishing Industry". Melliland Textillber., 43, (11), p. 1217-1222, 1962. (In German) An outline of the scale of the problems mentions that some of the largest finishers may use up to 16,000 m³ of water, which is discharged without clarification. Methods of purifying this effluent are critically examined.

9. Kehren, M. "Industrial Measures for the Purification of Air and Water". Textilveredlung, 1, (5), p. 219-227, 1966. (In German) The large-scale developments and the plant at Farbwerke Hoechst are described. Mechanical filtration and electrostatic precipitation are used in air cleaners. A pilot-scale water treatment plant has been used to develop a full-scale effluent and water plant dealing with 24,000 m³ per day.

discusses the properties of the various types of dyes used. He then gives the results of investigations into the treatment of aqueous solutions of dyes with metallic iron and iron salts.

11. Kehren, M. "Problems of Waste-Water Disposal in the Textile Industry". Part 3. Melliland Textilber., 11, p. 1274-1276 and 12, p. 1391-1395, 1963. (In German) This article discusses the problem of detergents in effluent, in particular the limiting quantities which can interfere with biological purification systems. The recent Swiss Turofloc process is described. This can produce clarification and removal of dyestuffs and detergents by direct flotation with aluminum chloride; this is followed by sludge removal and clarification over a synthetic resin, which is regenerated with caustic soda.


15. Kehren, M. "Technology and Economics of Sewage Treatment". CIBA-Rundschau, (130), p. 2-34, 1957. In a series of short illustrated articles the author deals with requirements with regard to the condition of sewage and waste waters discharged to streams; processes of self-purification and the organisms concerned; amount and chemical composition of waste waters from textile, leather, and paper works; processes and plant for the treatment of waste waters; the use of iron and iron salts in the treatment of waste waters containing dyestuffs; the design of modern plants for the treatment of very polluted waste waters by the Niers process and the Pista process; and plant and operation costs.

17. Kehren, M. "Waste Disposal in the Textile Industry". Textil-Rundschau, 16, p. 372-390, 1961; cf. Wasser und Abwasser in der Textil Industrie, 1951. A summary of the present status of the clarification of waste waters is given. Each process of disposal has to be adapted to the specific waste. All auxiliaries used should be suitable for biological decomposition, similar to soap. Trials made for this purpose showed that the fatty acid condensation product Ultrafon W is suitable. For chemical flocculation, Fe or Al salts prepared by bases or Fe shavings and O₂ can be used. Fe salts are preferred in amounts of 50 → 200 mg. Fe/l waste. The optimum pH for Fe Cl₃ is 6.2 and for FeSO₄ a range of 6.8 → 7.5. Fifteen references.


23. Kehren, M. "Water and Effluent. Part 4". Z. ges. Textil-Industrie, 68, (8), p. 602-606, 1966. (In German) This supplementary article publishes recent statistics on the consumption of water by industries in Germany, and the most recent news of surface-active agents which are biologically degradable. Four recent publications on fatty-acid sugar esters are summarized.

24. Kehren, M. "Water and Waste Water". Z. ges. Textil-Industrie, 69, (12), p. 937-942, 1967. (In German) This article is a supplement to an earlier series with the same title. The
information relates specifically to consumption figures and recent legislation in W. Germany. There are notes on the poisoning of river life by detergents.

25. Kehren, M., and H. Denks. "Behavior of Sulfides and Sulfur Dyes in Waste Water". SVF Fachvorgan. Textilveredlung, 12, p. 138-153 and 492-498, 1957. The treatment of waste waters containing sulfides and sulfur dyes is discussed. Sodium sulfide is removed by treatment with hydrochloric acid or a mixture of carbon dioxide and air, followed by aeration. Almost insoluble sulfur dyes cannot be precipitated by aeration or carbon dioxide alone, but can be removed by treatment with mixtures of carbon dioxide and air. Soluble sulfur dyes can only be precipitated with salts of heavy metals at pH 5.5.


27. Kennedy, J. G. "Developments and Equipment in Effluent Treatment". Dyer, 133, (12), p. 939-947, 1965. Developments in effluent disposal methods now adopted by the larger firms in the textile and dyeing industry are described. The separation of wool grease by precipitation with calcium chloride is chosen as one example. Methods employed to prevent pollution of the Danube by viscose manufacturing waste are mentioned. A complete system to treat dye manufacturing effluent has been recently installed (the Water Engineering Ltd three-stage process). Several other recent schemes are given brief mention.


29. Klein, L. "Stream Pollution and Effluent Treatment, with Special Reference to Textile and Paper Mill Effluents". Chemy. Ind., p. 866-873, 1964. After discussing the polluted condition of the river Irwell and other rivers in Lancashire and recent legislation to control pollution, the author indicates general measures that can be taken by industry to reduce the volume and strength of waste waters, including process changes, re-use of waste waters, and recovery of by-products. He then deals with the polluting materials present in waste waters from pulp and paper mills and from textile mills, the effects of the waste waters on receiving streams, and methods of treating these waste waters by physical, chemical and biological processes. A bibliography of 29 references is appended.


33. Kononova, E. F., N. M. Kabanov and I. K. Lysogorova. "Sanitary and Hygienic Investigation of Deep Discharge of Industrial Effluents into a Reservoir". Hyg. and Sanit. Moscow, 8, p. 13-18, 1960. (English summary) The authors describe a study carried out to determine the effect of deep discharge of aniline dye manufacture waste waters on the quality of water in the Gorky reservoir. The waste waters were discharged through pipes with multiple holes laid at a depth of 50 c.m. below the bottom of the reservoir. Results of chemical, bacteriological, biological, and other tests, which are given in tables and diagrams, reveal that discharge of the waste waters have no adverse sanitary effect on the reservoir water owing primarily to the high dilution factor.

34. Krasovskii, L. V. "Experience in Decontamination of Effluents from the Rodnikovsky Spinning Mill". Gig. Sanit., 32, (7), p. 98-99, 1967. (In Russian) A table is given showing the change in color, pH, suspended solids, B.O.D., etc., produced by a purification plant involving sand traps, settling basins, and aero-tanks. The coli-index required chlorination and a graph of residual Cl vs. dosage is included. Promising redns. of coli-index and no. of colonies were obtained with irradn. by using a low-pressure Ar-Hg lamp. The lamp was 55 mm. above the surface of the water, the depth was 75 mm., and the width of stream 140 mm. At 0.14 l./sec. this resulted in a 30-sec. exposure.


36. Kubelka, Vaclav. "The Pollution Problem from Industrial Waste Water, with Particular Reference to Tannery Wastes". Rev. Tech. Inds. Cuir., 50, p. 147-154, 1958. Kubelka discusses the pollution of water from industries and states that it is 20 to 50 times more severe than that from city sewage systems. The industrial waste water may contain materials with/without the same quality composition, and having the same or different concentration. The tannery wastes are fundamentally different
in composition and concentration at various times of the day, and their properties vary accordingly. Kubelka suggests some ways to minimize water pollution in industrial areas.

37. Kuisel, H. F. "Waste Water Treatment in Modern Textile Operations". Österr.-Abwasser-Rundsch., 11, (5), p. 80-84, 1966. (In German) Utilization of Lake Constance as a drinking water reservoir, and an agreement between Austria, Germany, and Switzerland, place limitations on waste water into the lake to: suspended solids <0.3 org. solvents and extractable matter by petroleum ether <10, B.O.D. <25, KMnO₄ consumption <80 mg./l., and absence of toxic matter, and temp. <30°. Activated sludge is poisoned by chemicals used in the textile industry (phenol, urea-formaldehyde, or mineral oils) as these are liberated in biol. treatment. Collection and mixing of all effluents of a textile plant is a partial solution to this problem, having excess Cl decolorizing dyes in soln. The temp. can be controlled by a heat exchanger, which also results in a fuel savings. The water is clarified and treated by activated sludge, to be used as an org. fertilizer. High pH and B.O.D. are reduced by aeration for 48 hours; hard detergents are to be excluded either by legislation or voluntarily. Phenol is to be removed in the plant by ion exchange, and may be recovered. Examples are given of treatment in various textile plants.

38. Kulakov, E. A. "Waste Waters from Factories of Primary Treatment of Wool, Their Purification, and Wool Grease (Lanolin) Recovery". Ochistka Prom. Stocnyka..., gidrogeol., sbornik, (2), p. 4-21, 1959. Countercurrent washing of one ton of wool gives an average of 30-43 cu. m. of sewage, whereas periodic washing gives 20-5 cu. m. with a content of approximately 200 kg. of wool grease and 700 kgm. of dry substance. Discharge of sewage into municipal sewers causes disturbances. For purification of the sewage, aeration is performed, and the collected foam (up to 94% of grease) twice centrifuged; the second centrifuging is done at 90-5°. Total recovery of fat contained in sewage is 52-61%.

39. Kulakov, E. A., and I. N. Myasnikov. "Purification of Waste Waters from the Viscose Rayon Industry". Zh. Vses. Khim. Obshchest., 12, (6), p. 638-644, 1967. (In Russian) The purification of waste waters obtained from production of viscose silk (900 m.³/ton), viscose reinforced staple (500 m.³/ton), viscose cord (700 m.³/ton), and cellophane (750 m.³/ton) is described. Sep. processes are suggested for removing all impurities, including acidity 4-8.5 meq./l., pH 2.5-2.8, CS₂ 20-100, H₂S 5-25, Zn 20-75, suspended material 120-470, dry residue 2700-6500, and calcined residue 2200-3500 mg./l.

also contain salts of Al, Fe, Cu, Cr, and other non-ferrous metals and arsenites and arsenates. The organic impurities are also very varied. For purification of these waste waters, the following process carried out at a centralized station, is recommended. There are three stages: 1) precipitation of organic substances and inorganic impurities settling out of solution when the pH falls below 5 (precipitation is accomplished in two series-connected clarifiers; the oxidizability is reduced 60-80%); 2) adsorption of molecularly dissolved impurities in countercurrent two-stage adsorbers with a suspended continuously renewable adsorbent layer; fine fractions (10.2 → 0.5 mm.) of activated anthracite are used as adsorbent; 3) heat regeneration of the adsorbent in a current of 0- less mixture of steam and combustion products of natural gas (700-900, 40-60 mm.). The waste waters have the following characteristics: solid particles 6000 → 1000 mg/l., pH 2.5, oxidizability 1125 mg/l.0; after purification solid particles—none, pH-7.8, oxidizability—39.5 mg/l.0, Cl absorbability 4 mg/l. Cl, phenols 0.27 mg/l.

1. Lamb, J. C., and A. B. Cherry. "Discussion of Chemical Treatment of Sewage and Industrial Wastes". Proc. 8th Sth. Munic. Industr. Waste Conf., p. 103-108, 1959. In discussing the paper by Ockershausen, R. W., the authors emphasize the need for considering the individual characteristics of each trade waste water when planning a coagulation or other chemical treatment process, and making the necessary laboratory and pilot-plant studies. With regard to coagulation, particular attention is given to the importance of determining the best order of addition of coagulant and coagulant aid, which varies according to the nature of the waste water. An example is also given of the factors to be considered in designing a process and a description and flow diagram are given of the neutralization process used at the Bound Brook plant of the American Cyanamid Company.


3. Lauria, D. T., and C. A. Willis. "Treatment Studies of Combined Textile and Domestic Wastes". Proc. 19th. Ind. Waste Conf., Purdue Univ., Engng Extn Ser. 117, p. 45-58, 1964. At Valdese, N. C., more than 80 per cent of the total waste flow consists of waste waters from the dyeing and finishing operations at textile mills. The existing sewage works are overloaded and, since the effluents are discharged to a creek flowing into a lake used for recreational and water-supply purposes, it was decided to carry out pilot-plant experiments to obtain data for the design of a new plant for biological treatment of combined domestic sewage and textile waste waters. Some results of operation of the pilot plant are summarized in tables and graphs. The method of treatment chosen was a low-loading completely-mixed process, and results showed that reductions in BOD of 90 per cent could be obtained with BOD loadings of at least 2 lb. of BOD per lb. of sludge per day. The oxygen requirements of the process were estimated to determine the capacity of aeration equipment required. The proposed new plant, which will have a capacity of 3.2 m.g.d., will comprise facilities for screening and grit removal, lagoons with mechanical surface aerators, sedimentation tanks, facilities for chlorination of effluents, and a solid-bowl centrifuge for thickening excess sludge before disposal as landfill.

5. Leclerc, E. "Study of Waste Waters from Dyeworks". Bull. Centre Belge Etude Doc. Eaux, (23), p. 39-51, 1954. The characteristics of the various types of waste waters from the textile industry are described and methods of treatment are reviewed with reference to previous studies as described in the literature. Preliminary studies of the waste waters for works engaged in the bleaching and sizing of cotton and linen are reported. The effluent is settled in five sedimentation tanks in series before discharge at a rate of 550 cu. m./hr. to the river Lys. Analysis of samples taken from the spillway to the river revealed no significant variations in the character of the effluent. During the day the effluent satisfies the condensation for discharge to a third-class (industrial) river in everything except amount of settleable solids which slightly exceed the limit. The waste waters become reoxygenated in the first sedimentation tank. Sedimentation reduces the B.O.D. of the waste waters from 270 mg. to 111 mg./liter. The B.O.D. of the river \( H_2O \) is increased by 20% by the discharge of the effluent; it is already heavily polluted at this point by other trade waste waters. Results of experiments on the harmfulness of the waste waters to fish are given in tables.

6. Lerczynski, S., J. Mokry, S. Ramotowski, and J. Stepień. "Purification of Sewage from the Production of Viscose Rayon". Przemysl. Chem., 43, (7), p. 389-394, 1964. Methods of purification such as coagulation, sedimentation, and flocculation and difficulties encountered are discussed. Aluminium sulphate coagulants in amounts of 50-80 mg/l are shown to give a 30% higher purification than other methods such as precipitation in an acid medium or with milk of lime. Additional biological purification is unnecessary.

7. Ling, Joseph T. "Pilot Investigation of Starch-Gluten Waste Treatment". Purdue Univ., Eng. Bull., Ext. Ser. No. 109, p. 217-231, 1962. The principal waste involved had a five-day BOD of 12,000 parts per million, consisting of 800 parts per million suspended solids and 15,000 parts per million total solids, of which 14 per cent was protein, 7 per cent starch, and 79 per cent carbohydrate. Of the carbohydrates, 62 per cent was reducing sugar. A pilot scale anaerobic digester was tested during a three-week period. Eighty per cent removal of volatile solids was accomplished at a loading of 0.1 lbs. volatile/cu. ft. digester vol./day. The maximum allowable loading was not reached. Anaerobic lagoonng was simulated in 55-gal. drums, and was successful if seeding was included. A minimum of 50 per cent removal of volatile solids was observed in seeded lagoons when they were operated at 32-43°F. for 11 weeks. The loading applied to the lagoons was 0.022 lbs. volatile solids/cu. ft./day. No objectionable odor was observed in the seeded lagoons within four weeks. Settling of the wastes for 2.5 hrs. was most economical, and this by itself removed 35 per cent of the suspended solids.

9. Little, A. H. "Textile Works Effluent Treatment". *Textile Inst. and Ind.*, 1, p. 9-11, 1963. The author discusses the effect of recent British legislation concerning pollution on the textile industry, and indicates typical requirements for the discharge of waste waters to municipal sewers and to surface waters. He outlines possible methods of treatment for textile waste waters and indicates some of the costs of treatment and disposal.

10. Little, A. H. "Treatment of Textile Waste Liquors". *J. Soc. Dyers Col.*, 83, (7), p. 268-273, 1967. The character of textile waste liquors and methods that can be employed for their purification are discussed. Although the examples are based largely on cotton processing, the methods are applicable generally. The need for mixing and balancing waste liquors is emphasized. Methods of biochemical treatment are described with some indication of the relative costs. The method usually used to remove suspended solids is described briefly, and the effects of oxidizing and reducing substances on the biochemical treatment are discussed. The ease of treatment of effluents containing surface-active agents depends on whether the agent is "hard" or "soft", i.e., whether the agent has a high or low BOD. If the waste is discharged to a sewer, the treatment costs depend on the size of the community in which the works is situated. The re-use of part of the effluent from textile processes and the analytical tests made on the effluent are discussed briefly.


13. Lotoshnikov, Yu. F. and O. N. Kukisheva. "The Volumetric Determination of Sulfate in Waste Waters". *Khim. Volokna*, (1), p. 72, 1968. (In Russian) $SO_4^{2-}$ in textile waste water was detd. with a relative error of <2% by a rapid volumetric procedure. Five drops of 0.2% ag. alizarin red was added to a waste water sample contg. 0.1-15 g. of $SO_4^{2-}$/l., and the sample was acidified by addn. of HOAc. If an inorg. acid was present it was first neutralized with NaOH. EtOH was added, and the sample was titrated with 0.1 N BaCl$_2$. The anal. took ~15 min. The presence of $\leq 20$-5 g. of Zn$^{2+}$/l., $\geq 100$ mg. of Fe$^{3+}$/l., $\geq 10$ mg. of Al$^{3+}$/l. did not interfere.
14. Ludemann, D. "The Effect of the Dyestuff Luxantholschwarz G on Fish. A Contribution to the Harmfulness of Coloured Waste Waters". Z. angew. Zool., 44, p. 97-102, 1957. (English summary) Luxantholschwarz G (I), frequently occurring in coloured wastes of the textile industry, is a special dye used for viscose and cuoxam. I was toxic to guppies and bitterlings at concentrations of 5 and 75 ppm., respiratory gills of affected fish were blocked by particles of I, frequently resulting in gill destruction.

15. Lukinych, N. A. "Waste Water from the Wool Industry". Sanit. Tech. U.S.S.R., 3, p. 137-160, 1954. An investigation is described of the waste waters from a number of works of the wool industry; these are divided into three groups, those dealing with crude wool, spinning and weaving works, and works treating the prepared material. The water demand of 15 processes and analyses of their waste waters are given. Waste washing waters are alkaline, have high contents of suspended matter and grease, and have a high BOD. Waste waters from factories dealing with crude wool must be treated for removal of fibrous material and grease. Processes for removal of grease are described and a combination of centrifuging with acid treatment is recommended.

2. McCarthy, J. A. "A Study on Treatment of Wool Scouring Liquors". Sanitalk, 3, (3), p. 17-18, 1955. Studies on the treatment of wool scouring waste waters made by the Lawrence Experiment Station, Massachusetts, have shown that coagulation with CaCl₂, usually 2% by weight, with the introduction of live steam and adjustment of pH value gives up to 98% reduction in concentration of grease and 66% reduction in BOD. The treated waste waters still contain about 500-800 ppm grease and have a BOD of 4000-7000 ppm. To assess the permissible loading and probable removal of BOD in treatment of the waste waters by biological filtration, several series of filters were operated, the liquor being applied in a mixture with rinsing waters, which are usually available in volumes 3 to 10 times greater than those of scouring waste waters and have a relatively low BOD and grease content. The loading applied to the filters was usually 2000#/acre-ft. and the proportion of liquor to rinsing waters applied to two recirculating filters in series varied from 25% to 10% scouring liquor, the corresponding reduction in BOD of the mixture increasing from 60 to 83%. The grease content was reduced by 90%. These results indicate that wool scouring liquors with a BOD of 16,000 ppm before coagulation can be treated by two-stage biological filtration after dilution with 90% rinsing waters.

3. McCarthy, J. A. "Characteristics of Wool Dyeing Wastes and Experimental Treatment". Sanitalk, 1, p. 8-11, 1952. A report on the use of experimental trickling filters for treating the two types of wool dyeing wastes. The top dyeing waste contains little suspended matter and much of the BOD is in solution. Ordinary coagulants are generally ineffective and even prolonged sedimentation gives little improvement. Storage in lagoons may result in some reduction in color, but little reduction in BOD. With standard trickling filters it was found that loadings of 1000 to 1500 pounds of BOD per acre foot resulted in a BOD reduction of 90%. Recirculating the wastes through the filters with a ratio of 5 to 1 showed that BOD loading could be gradually increased to 5000 lbs./acre ft. with an 89% reduction in BOD. Vat dyeing wastes while lower in BOD, required a reduction in filter loading to 1000 lbs. of BOD per acre foot in order to obtain a 90% reduction. Recirculation of this waste through the filters increased the loading only 30 to 40 per cent. As both types of dye wastes are customarily found in the same mill combining these two wastes gave satisfactory effluent through trickling filters with loadings of 1200 lbs. of BOD per acre foot.
McCarthy, J. A. "Effect of Starch Substitutes on Textile Wastes". Sanifalk, 4, (1), p. 23-25, 1955. The extensive use of starch in the processing of textiles, the processes involved, and the high BOD of textile waste waters resulting from its use are outlined. Investigations made at the Lawrence Experiment Station, Massachusetts, on the BOD of starch solutions and solutions of starch substitutes made up to 0.1% solutions, as used in textile mills, showed that whereas the BOD of starch solutions averaged from 600 to 1000 ppm, figures for substitutes were considerably lower, and that in mixtures of starch and CMC exertion of the BOD was retarded. The efficiency of treatment of starch and CMC mixtures on percolating filters was also studied. It was concluded that a reduction in the BOD of textile waste waters could be effected by the use of starch substitutes, giving a reduction in the pollutional load discharge to streams and a reduction in the cost of textile waste treatment.


McKinney, R. E. "Syndets and Waste Disposal". Sewage and Ind. Wastes, 29, p. 654-666, 1957. Sewage and water treatment problems due to synthetic detergents are examined and research efforts to solve these problems are noted. Forty-one references.

11. Mackowiak, Jacek. "Comparison of Determination of Organic Compounds in Retting Waste Waters by Chemical and Biochemical Oxygen Demand Methods". Prace Inst. Wlckien Lykowych, 12, p. 141-152, 1965. (In Polish) In order to find the most appropriate method for detg. the chem. O demand (C.O.D.) of retting waste waters and its correlation with B.O.D. as detd. by the diln. method, expts. were carried out on detn. of C.O.D. of pure compds. contained in the waste waters and of the waste waters themselves. Among chem. methods, the dichromate standard method involving Ag2SO4 as catalyst gave most satisfactory results. Statistical treatment of results led to a correlation formula between B.O.D. and C.O.D. in the form: 
\[ y = 0.6386x \]
where y is B.O.D. in mg. O/L and x is C.O.D. in mg. O/L. Cl- ions in concns. found in retting waste waters have no influence on the detn. of C.O.D. by the standard dichromate method.

12. Maddox, T. "Unique Treatment Plant for North Georgia". Water and Sewage Works, 109, p. 325, 1962. An industrial wastes treatment plant has been constructed for the Chicopee Manufacturing Corporation's textile factory at Gainesville, Georgia. Waste waters from this factory were discharged into Bailes Creek before pollution was increased by the construction of Lake Lanier. The new plant will provide single-stage biological treatment with aeration for up to 40 hours to enable the micro-organisms to become adapted to variations in the composition of the waste water, thus avoiding the need for further treatment.


14. Mal'kov, V. A. "Function of Sedimentation Tanks in Semi-Industrial Plant for Effluent Purification". Khim. Volok., (3), p. 64-66, 1967. (In Russian) Experimental work on the use of vertical and horizontal settling tanks in the purification of viscose-production effluent is reported. The vertical tanks are shown to have three times the capacity of the horizontal tanks in achieving the same degree of purification but the problem of removal of the sediment is more complex.


16. Mal'kov, V. A. "Use of Clarifying Agents for Purifying Waste Waters from Rayon Production". Vodosnabzh. Sanit. Tekhn., (1) p. 7-11, 1968. (In Russian) Waste waters from rayon production contain H2SO4 21-2000, Zn2+ 10-150, Fe 1-8, and suspended material 27-300 mg./l. (pH 1.7-2.8). Preliminary clarification by liming with 3-5% Ca(OH)2 was very satisfactory, and
the most efficient continuous clarifier was the slot type. At a settling rate of 1.4 mm./sec., 89% of the deposit could be removed, and 87% of the Zn removed (ZnSO₄ was converted to insol. Zn(OH)₂ at pH 9.5-11). The treated wastes then contained suspension 56 and Zn 4.6 mg./l. At a settling rate of 0.4-0.5 mm./sec. somewhat better results were obtained. The sludge carried off had 98-9% moisture, and the dry deposit averaged 3-4% of the waste vol.

17. Mambet, E., E. Cute and L. Weiner. "Studies on the Treatment of Waste Waters from the Textile Industry". Stud. Proct. Epur. Apel., Bucharest, 4, p. 307-332, 1962. (French summary) The waste waters from different processes in the textile industry are highly variable in volume and composition, and the Institutul de Studi si Cercetari hidrotechnice of Roumania has carried out tests on the types which are most difficult to treat; namely, those from the washing of wool, spinning of natural silk, and finishing of cotton, wool, and artificial silk fabrics. Data on the physico-chemical characteristics of the waste waters are reported in tables and graphs, and pilot-plant studies are described on possible methods of treatment for waste waters from the finishing of wool and artificial silk. The wool finishing waste waters were generally alkaline, with a five-day BOD of 390-317.0 mg./l. and a highly variable color which disappeared at dilutions between 1/5 and 1/500. With the artificial-silk finishing waste waters, the color disappeared at dilutions between 1/7 and 1/10, the pH value was 6.5-9.0, and the five-day BOD was 85.0-130.0 mg./l. The studies showed that in treating these waste waters, particular attention should be given to the removal of color. The best color removal, with simultaneous improvement of pH value, was obtained by treating the wool-finishing waste waters with CaCl₂ and aluminum sulfate in doses of 1.0-2.0 kg. and .2 kg./m³, respectively. These treatments also reduce the quantity of sludge produced by chemical treatment of the waste waters. After this treatment for color removal, both wool and artificial silk finishing waste waters resemble domestic sewage and can be treated biologically at the municipal sewage works.

18. Marinich, V. K., N. L. Shevchenko, and O. V. Firsova. "The Use of Weak-Acid Cationic Agents to Remove Zinc from Highly Mineralized Waste Waters". Khim. Volok., (2), p. 63-65, 1967. (In Russian) Zinc compounds can be almost completely removed from waste waters with the aid of weak-acid cationic agents KB-4 and KB-4P-2. On average, the consumption of agents normally used in effluent purification (soda, caustic soda) is reduced by 30% the method is less cumbersome in application, and less equipment and plant is required. The method is suitable for the removal of zinc from highly mineralized effluent from viscose cord and staple fibre production.


21. Masselli, Joseph W. and M. Gilbert Burford. "Pollution Reduction in Cotton Finishing Wastes Through Process Chemical Changes". *Sewage and Ind. Wastes*, 26, p. 1109-1116, 1954. Results of an effluent survey of a cotton finishing plant were compared with data derived from an inventory of the BOD values of process chemicals used. The former indicated a discharge of 123 pounds and the latter 155 pounds BOD per 1,000 pounds of cloth. Process chemicals were shown to contribute 70-80% of the total BOD with starch, soap, and ACOH the major sources; 20-30% of the BOD was attributed to the natural waxes and pectins extracted from the cotton fiber during scouring. The possibilities are indicated of pollution reductions of 50-75% by substitution of low BOD chemicals for those now used; cellulose ethers for starch. Desizing and scouring contribute 35 and 32% of the total BOD, respectively.


23. Masselli, J. W., and M. G. Burford. "Pollution Sources from Finishing of Synthetic Fibers". Available from New England Interstate Water Pollution Control Commission, 73 Tremont Street, Boston 8, Massachusetts, 24 pages, 1956. This report records the research conducted for the Commission by Wesleyan University on wastes resulting from the finishing of synthetic fibers, and provides a companion report to those previously published by the Commission on cotton and wool mill wastes. Result of all three studies. 19 references.

24. Masselli, J. W., N. W. Masselli, and M. G. Burford. "A Simplification of Textile Waste Survey and Treatment". Report to New England Interstate Water Pollution Control Commission, Boston, Massachusetts, 68 pages, 1959. This report contains an outline of the processing methods and sources of pollution in the finishing of cotton, wool, and synthetic fibres; advice on the simplification of pollution survey methods in the textile industry; an assessment of the range of pollution load from specific processes; and suggestions on the reduction of pollution load and simplification of methods for treating the waste waters. In cotton mills, most of the pollution results from desizing and kiering operations, and in woolen mills, from scouring and washing after fulling; and it is emphasized that the first step towards pollution control should be the modification of processes to segregate these wastes as a single
concentrated waste water which would require only small storage capacity to permit equalization of the discharge of BOD over 24 hours instead of shock loads and would also separate the toxic and other troublesome constituents of the weaker effluents, normally responsible for the great variability in textile waste waters and preventing adequate treatment. The segregated concentrated waste water could be treated by evaporation and incineration, or the woolen mill waste could be treated by chemical coagulation with calcium chloride and the cotton mill waste, after dilution, by biological filtration or the activated-sludge process. The pollution loads of the remaining weaker effluents, and also of the waste waters from the finishing of synthetic fibres, are entirely due to chemicals used in processing; suitable chemicals should therefore be developed which have lower BOD values or are easily removed from the waste waters. Other research should include the development of methods for recovering materials from the waste waters or utilizing the waste waters; the collection of data on the BOD of processing chemicals; and basic research on the reactions of substances primarily responsible for the BOD of the waste waters (principally glucose, soap, and natural impurities). Numerical data are appended on the composition and BOD of the various processing chemicals, the analysis and pollution potential of typical waste waters, and the removal of BOD by chemical coagulation.

25. Masselli, J. W., N. W. Masselli, and M. G. Burford. "Wool Processing and Stream Pollution". Textile Inds., 125, p. 121, 128, 132, 137, and 142-144, 1961. It is shown that natural impurities extracted from the wool (wool wax and suint), soap, carding oils, and acetic acid produce practically all of the BOD from the wool industry. The natural impurities may be removed through solvent recovery and soap may be replaced by low BOD detergent or sulfuric acid. Acetic acid may be replaced by ammonium sulfate and low-BOD carding oils may replace the high-BOD oils usually used. These changes can reduce BOD loads by 60 to 90%.


27. Matov, B. M. "Electric Flotation of Suspended Particles with the Use of Flotation Reagents". Elektron. Obrab. Mater., Akad. Nauk Mold. SSR, (3), p. 80-82, 1966. (In Russian) Waste water from a silk production plant has been clarified by flotation of suspended particles in an electric field. Various flotation reagents were used; optimum conditions were obtained with 0.4 g/l of ferric chloride.


30. Mazaev, V. T., and I. N. Skachkova. "Discharge of Industrial Wastes Containing Urea Into Water Reservoirs". Gig. Sanit., 31, (10), p. 7-12, 1966. (In Russian) Urea is only slightly toxic, rats receiving 50 mg./kg. showed practically no increase in blood urea concn. The threshold for detection by taste is 10 mg./l. Urea does not affect B.O.D., but after hydrolysis the NH₃ formed consumes O on being oxidized to NO₂⁻ and NO₃⁻. The discharge of urea into a stream should be based on this consumption of O.


32. Mejstrik, B., F. Sillinger, and N. Sebkova. "Purification of Waste Water from Dye Production". Veda a vyskum v prumyslu textil., 4, p. 105-111, 1958. Different methods of purifying waste waters are described. The proposal is to diazotize waste waters of one plant and couple them with inactive components from the waste water of another plant.

33. Merkel, N. "Treatment of Waste Waters from the Textile Finishing Industry". Melland Textilber, 36, p. 293-294, 1955. About 2/3 of the waste waters produced in a textile finishing factory are relatively unpolluted and are kept separate from the polluted waters. Heavily polluted waters are mixed in sedimentation tanks holding about 3-5 hours output. By the mixing of different types of waste waters flocculation is encouraged and is completed by addition of FeS0₄, other iron solutions, or sludge from water softening. Final biological treatment usually takes place in sewage works. Sufficient dilution for reduction of color is important.

34. Mikhailov, A. Z. Ioffe, N. I. Zubkova, and V. I. Maiboroda. "Purifying Alkaline Waste Waters of the Viscose Industry". Leningrad Branch of the All-Union Scientific-Research Institute of Synthetic Fibers. USSR P. 201,984, (Cl. C 02b), September 8, 1967, Appl. June 29, 1964. Alk. waste waters of the viscose industry are purified with the aid of thermohydrolysis. To intensify the process, the purification is conducted in the presence of metal oxides as catalysts.

35. Mindler, A. B. "The Economics of Base Metal Recovery by Ion Exchange". Met. Soc. Conf., 24, p. 851-859, 1963. Data are presented to demonstrate that industry producing base metals may profit by ion exchange, esp. where the metal concn. is low. The examples are taken from the textile industry in which 5,000 tons Cu and Zn, as oxides, are recovered each year from waste solns. Costs are given for the Zn circuit, but the costs should be similar for a Cu circuit. Also a new process (Abiperm) is described for recovering Na from sulfite pulp waste liquors.
36. Miyaoka, Uichiro and Minoru Masunaga. "Evaluation Method of Commercial Enzymic Desizing Agents". J. Soc. Textile Cellulose Ind. Japan, 9, p. 605-608, 1953. The solubility of simple starch size was detected in order to estimate the transition of a sizing agent into a soluble state. This simple method was applied to compare commercial enzymic desizing agents and also to detect the residual starch on fabrics within ±5% error.

37. Mokrzychi, J. "Investigation of Sewage Purification by the Activated Sludge Process". Prace Inst. Wlok., 11, p. 116-127, 1961. (In Polish) Some results of experiments carried out on sewage from the city of Lodz, which consists of 80-85% industrial effluent (50% of textile origin) and 10-15% domestic effluent, and is high in Cr, Cu, Zn, and detergent content, are reported.


39. Mokrzycki, J., J. Zawadzki and K. Kielar. "Purification of Waste Waters Containing Latex". Prace Inst. Wlok., 13, p. 149-162, 1963. (In Polish) A study has been made on the purification of sewage containing textile binding materials of the latex type, aluminum sulfate, iron sulfate, and iron chloride are suitable coagulants; optimum doses of coagulant have been determined.


41. Mordvintseva, G. M. P., V. V. Grabovskaya, V. K. Marinich, and S. M. Naigauz. "Use of Unicellular Algae for Purifying Waste Waters from Synthetic Fibre Undertakings". Khim. Volokna, 3, p. 61-62, 1966. Laboratory and pilot-plant experiments are reported on the use of unicellular green algae (Chlorella and Ankistrodesmus) to treat waste waters from the manufacture of synthetic fibres (Kaplon and viscose). Growth of the algae could be stimulated by addition of nutrients, such as urea, magnesium sulphate, and potassium phosphate. It was found that treatment, which was complete within 6 days under laboratory conditions and 3 days in the open air, effected complete removal of zinc, iron, hydrogen sulphide, carbon disulphide, and sulphides, reduced the BOD by 90 per cent, and increased the dissolved-oxygen concentration by 100-400 per cent, but had no effect on calcium and sulphates.


45. Morton, T. H. "Water for the Dyer". J. Soc. Dyers Colour., 83, (5), p. 177-184, 1967. The dye industry of England and Wales uses approximately 10% of the annual surface water run-off. Increasing use, uneven distribution, and water management problems are discussed in terms of the dyeworks water supply and effluent disposal. Water quality required and processes used to produce satisfactory waters for the dyeworks are discussed in relation to surface, impounded or subsurface supplies. Effluent disposal for dyehouse waste waters are under control of local or river authority by prearrangement. Diln. in municipal waste waters may simplify treatment where biol. processes are acceptable. On-site treatment is likely to be more complex. Certain surfactants, dyes, and auxiliary agents may correspond to alkylbenzenesulfonate in treatability. Process modification to provide effluents more amenable to treatment include substitution of dyes with more favorable color removal, recovery of grease and fatty acids, and re-selection of surfactants and auxiliary agents. These alterations increase costs but are essential under present and anticipated conditions.


47. Mytelka, A. I., and R. Manganelli. "Energy-Induced Changes in an Azo Dyestuff Waste". J. Water Pollution Control Fed., 40, (2), I, p. 260-268, 1968. Sterilization of water and wastewater by means of radiation is based on energy induced changes in the waste and the effect of these changes on subsequent biological oxidation. The industrial waste selected for testing was an azo dyestuff mother liquor with low biodegradability and intense color. The ionizing radiation source was cobalt-60 gamma rays. Parameters investigated include total organic carbon (TOC), COD, BOD, dye concentration, color, solids, and pH. Results show a decrease in the above variables, and a waste more amenable to biological oxidation as radiation dosages increased. 20 references.


6. Nemerow, N. L. and W. R. Steele. "Dialysis of Caustic Textile Wastes". Proc. 10th Industr. Waste Conf., Purdue Univ. Eng. Extn. Ser., (89), p. 74-81, 1955. In processing of cotton goods the waste waters from the mercerizing, kiering, and vat dyeing of the cotton are all strongly alkaline, with high BOD and excessive mineral content, and are colored. Dialysis of the waste waters to separate pure NaOH from the impurities, such as hemicelluloses, pectins, waxes, and dyes, has been successful. The Solvay-Brosies dialyser has been developed to treat textile waste waters after concentration to about 38-40 per cent caustic soda in vacuum evaporators, cooling, and filtration.


8. Neubart, S. "Reclamation of By-Products in Wool Scouring". Industrie Textile, p. 615-620, 1964. (In French) The author describes the extraction of wool grease from scouring effluent by the methods of acidification, flotation, calcium chloride treatment, and centrifuging. The chemical treatment of the grease and its uses are discussed. There is a description of the traditional method of reclaiming potassium, and details of a method developed by the author are given.


12. Nosek, Jaromir. "Waste Liquors from the Mercerization of Cotton Fabrics and Limiting of Waste Water Alkalinity". Vodni Hospodarstvi, 16, (7), p. 288-291, 1966. (In Czech.) In the mercerization process, the consumption of mercerization lye depends mainly on the humidity of the fabric entering and leaving the mercerization machine. To reduce the lye consumption, increased wringing by the machine and use of waste liquor for the dissolution of the fresh lye are suggested. The economics of the neutralization of the waste liquor by H2SO4, HCl, FeSO4.7H2O, and CO2 (flue gases) and the salt content of the neutralized waste water are discussed.


14. Nosek, J. and J. Krepelka. "Clarification of Textile Wastes by Means of Magnesium Chloride". Vodni Hospodarstvi, 9, p. 556-557, 1959. Full-scale tests of clarification of textile wastes by means of MgCl2 showed that, in a highly alkaline medium, it is a very effective clarification agent. The use of MgCl2 is especially advisable for laboratory tests, as the color of the originally white Mg(OH)2 may be a good indicator of the quantity of dye removed.


16. Nosek, J. and others. "Clarification of Textile Waste Water Through the Use of Wet Transfer of Slag and Ash from Steam Boilers". Vodni Hospodarstvi, 11, (8), p. 358-359, 1961. (In Czech.) The quality of textile waste water, clarified by wet transfer, is approximately 40% as compared with the clarification of almost 50% obtained with ferrous sulfate and calcium hydroxide.
17. Nosek, J. and V. Vondrlik. "Experiences in the Treatment of Textile Waste Waters on a Percolating Filter". Voda, 32, p. 226-228, 1953. The waste waters from a dyeing, printing, and bleaching works are treated successfully by filtration through a 1-m. layer of brown coal slag. The BOD is reduced by 35-45% and color is reduced by 80-90% and frequently completely removed.


19. Nosek, H. "Rational Control of the pH at the Catchment Area of a Sewage System". Spinner Weber Textilver., 83, (3), p. 249-251, 1965. (In German and English) The application and interpretation of the results from a continuously recording pH meter are discussed. Details of the electrode assembly are omitted; it is claimed that a satisfactory record is obtained for several days' operation in flowing effluent which contains fibrous waste. The equipment is designated the pH 200 meter by the makers, Wissenschaftlich-Technische Werkstatten G.m.b.H.


21. Nowacki, J. "Wool Industry Waste Waters". Gaz, Woda i Tech Sanit., 3, p. 65-90, 1956. Laboratory experiments have been carried out at the Silesian Technological Institution on the preliminary treatment of waste waters from the wool industry before discharge to the municipal sewers. Waste waters containing acid chrome and metachrome dyes can be treated with H2SO4 and FeS04 and mixed in an equalization tank with waste waters from the washing houses and with dye wastes previously treated by coagulation with lime and ferrous sulfate. Finally the mixed waste waters are settled before discharge.


7. Osherelyava, M. N. "Treatment of Waste Waters from the Wool Industry". Vodosn. i Sanit. Tekh., (12) p. 14-15, 1959. The composition and treatment of wool washing waste waters are discussed. Treatment with lime and ferrous sulfate is insufficient. Experiments with ferric chloride showed that this treatment increased clarity, reduced suspended matter from 3043 mg to 435 mg/l and reduced BOD by 50%. Addition of lime was necessary only if the pH value required adjustment before discharge to a stream.

2. Palamar-Mordvintseva, G. M., V. K. Marinich, V. V. Grabovskaya, and S. M. Neigauz. "Clarification of Sewage from Synthetic Fiber Factories with the Aid of Single-Cell Algae". *Ukr. Botan. Zh.*, 23, (5), p. 56-61, 1966. (Ukrain) Expts. were conducted in open basins to confirm data obtained under lab. conditions on the possibility of cultivating Chlorella algae on sewage from synthetic fiber production for the purpose of clarifying the sewage. Growth and development of algae and clarification of sewage were more rapid under natural conditions than in the lab. The main clarification was completed in 1 day in the presence of algae. A 3-day cultivation of the algae removed Zn, H2S, S, and sulfides (100%) and CS2 (60%), and decreased B.O.D. by 92.5%.

3. Palamar-Mordvintseva, G. M., V. V. Grabovskaya, V. K. Marinich, and S. M. Neigauz. "Use of Unicellular Algae for Purifying Waste Waters from Synthetic Fibre Undertakings". *Khim. Volok.*, (3), p. 61-62, 1966. (In Russian) Experimental work (both in the laboratory and in the open air at effluent-treatment plants of factories producing Kapron and viscose) on the use of unicellular algae (Chlorella and Ankistrodesmus) is reported. The growth of the algae in the waste waters can be stimulated by the addition of "food" salts (urea, magnesium sulphate, and potassium phosphate). Removal of zinc, iron, hydrogen sulphide, carbon disulphide, and sulphides is 100%; the quantity of free oxygen is increased by 100-400% and the B.O.D. is reduced by 90%; only the calcium and the sulphates remain unaffected. Complete purification is achieved on the sixth day under laboratory conditions and on the third day in the open air. The work is regarded only as preliminary; no account of economic aspects has been taken. Further projected work on the possibility of cheapening the process by using by-products of the food and distilling industries is mentioned.


dried milk and textile wastes from an operating cotton mill. The wastes were tested manometrically. These manometric tests were followed by tests in a laboratory model, two-stage activated sludge plant. The combined waste could be effectively treated (parameter, initial value, and percent reduction in primary and secondary stage, respectively): B.O.D. 330 mg./l., 70, 94; Chemical Oxygen Demand (dichromate) 606 mg./l., 60, 77; Chemical Oxygen Demand (permanganate) 178 mg./l., 75, 84. Initial pH was 8.8-9.6. Shock loading to alkaline pH was adequately handled. $S\text{O}_4^{2-}$ 17, Cr 1.68 (as $K_2Cr_2O_7$), and Cu (as $CuSO_4$) 41 mg./l. were without effect. Retention times of one hour in the primary and three hours in the secondary stage yielded acceptable results.

7. Petru, A. "Combined Treatment of Wool Scouring Wastes and Municipal Wastes". J. Inst. Sew. Purif., (5) p. 497-499, 1964. Pilot-plant experiments showed that, after pretreatment with calcium hydroxide and calcium chloride and a centrifuging treatment to remove as much grease as possible, wool scouring wastes can be treated together with municipal wastes in a ratio of 1:10. Reduction in BOD was of the order of 70 percent and that in COD of 40-60 percent.


9. Peyron, E. "Effluents from Dyeing and Finishing Baths". Teintex, 32, (6), p. 419, 421-422, and 425, 1967. (In French) The treatments of dyeing and sizing effluents used in the textile industry were discussed. The autoneutralization, pH regulation, flocculation, decolorization by C and decantation processes involved were described. The installation steps used for a textile printing plant were discussed. The various effluents were combined in an equilization bath provided with a surface skimming device and an aeration system by compressed air. Flocculation is carried out by $Al_2(SO_4)_3$ and Na silicate in a special tank. CaCl$_2$ used for deolorization is distributed automatically and is controlled by a galvanometric device.

10. Pinault, R. W. "Textile Water Pollution Cleanup Picks Up Speed". Textile World, 117, p. 52-66, 1967. The problem of textile water pollution and what government regulations mean to the textile manufacturer are examined. Factors to be considered in the selection of an effluent treatment system are discussed and case studies of the waste treatment plants now in use at five different textile mills are cited.


14. Pleshakov, V. D., O. P. Sinev, V. S. Semenova, and L. F. Lupanova. "Settling of Sewage from Viscose Fibre Production at High pH". *Tr. Novocherk. Politekhn. Inst.*, 157, p. 47-53, 1964. (In Russian) Conditions necessary for the effective settling of suspended solids and zinc from viscose fibre production effluent in horizontal settling tanks have been investigated. Both complete preliminary regeneration of cellulose hydrate from the viscose solution and intense mixing of the effluent with lime are shown to be necessary; the pH should be less than 9.0. Some comments on the design of the settling tank are also offered.

15. Popov, Kh. "Determination of Chloride Ions and 2,4-dinitrochlorobenzene in Sewage from Sulfur Dye Production". *Khim. Ind.* (Sofia), 37, (5), p. 164-168, 1965. (In Bulg.) In the absence of 2,4-dinitrochlorobenzene (I), Cl⁻ is detd. by dilg. a 5-10 ml. sample with distd. H₂O, in a sufficient amt. of 0.1N AgNO₃ is added for the complete pptn. of chlorides, sulfides, polysulfides, sulfites, and thiosulfates, plus 2-3 ml. excess, an amt. of HNO₃ is added equal to 0.5 the vol. of the test soln., glass beads are added, and the mixt. is boiled for 4-5 min. If the soln. is not completely colorless, 20-30 ml. dil. HNO₃ (1:2) is added, and the soln. reboiled. After cooling to room temperature, the soln. is filtered to remove AgCl, and the ppt. is washed to a neg. Ag reaction with very dil. (0.02-0.05N) HNO₃. The filtrate and wash waters are combined, and the detn. is completed by using Fohlards method, where the excess AgNO₃ is titrated with 0.1N NH₄SCN, using FeNH₄(SO₄)₂ as indicator to a rose-red color. Where I is present total Cl⁻ is detd. by boiling the sample with 8% NaOH in order to transform molecular Cl in I to Cl⁻, and the analyses completed as above. A sep. analysis for Cl⁻ without this transformation gives Cl⁻ content without the mol. Cl from I and the amt. of I can therefore be calcld. by difference.

16. Popov, Kh. "Development of a Method for Treating Waste Waters Containing Sulphur Dyes from the 'Asen Zlatarov' Plant, Iskar Station, Sofia". *Trud. nauchoizsled. Inst. Vodosnab. Kanaliz. sanit. Tekh.*, Sofia, 2, p. 167-184, 1965. (English summary) Laboratory tests showed that the most economical and effective method for the treatment of waste waters containing sulphur dyes was acidification with sulphuric acid to give a pH value of 3.5-4, followed by neutralization with lime to give a pH value of 8-8.5, the neutralization tanks being closed and
slightly pressurized. The sulphur dioxide and hydrogen sulphide which are evolved react together and become harmless, and the treated waste water is suitable for discharge to the municipal sewer. Based on the results of the tests, which are given in tables and graphs, a treatment plant was designed and is shown diagrammatically. The pH value during acidification and neutralization will be controlled automatically. A period of 2-2.5 hours is required for sedimentation and 1-1.5 hours for neutralization. Alkaline sludge can be re-used.

18. Popp, P. "Methods for the Purification of Waste Water From Super-cord Rayon Production". Faserforsch. U. Textiltech., 13, (10), p. 462-472, 1962. Laboratory and pilot-plant tests have been carried out on a method for purifying waste water from the production of supercord rayon, which is cheap and needs very little space; it is carried out at pH 10 using lime water. A flow diagram for a planned purification unit is included.

19. Postnikov, I. S. "Waste Waters from Cotton Spinning and Weaving". Sanit. tech., U.S.S.R., 3, p. 113-136, 1954. The author describes investigations on the waste waters of two cotton factories which included bleaching, dyeing, and color printing plants. Detailed analysis of waste waters from the different processes are given in tables. The investigation was especially concerned with the suitability of the waste waters for discharge to the sewers and recommendations made include the following: Waste cooling water from the spinning and weaving process should as a rule not be discharged but re-used as cooling water after mechanical treatment. Slightly polluted waters from bleaching and dyeing can generally be discharged to the sewers and serve to dilute concentrated dyeing wastes. Direct discharge of other waste waters is permissible. Washing water from the filters, spinning, weaving, and bleaching, must be screened to remove fibers and other matter likely to block sewers. To prevent damage to sewers by high temperature, acidity or alkalinity, the flow should be equalized. The toxic action of waste waters containing $H_2SO_4$ from dyeing should be removed by aeration or chlorination. If the sewage works include biological treatment, the mixed sewage and waste waters should have a pH value of 6 → 9; the maximum permissible contents of toxic substances are (mg/1) Cr$^{2+}$, Zn$^{2+}$, Pb$^{2+}$, Sb$^{3+}$, CN$^{-}$ → 1; As$^{+}$2. The BOD must be controlled and attention paid to the pH.

20. Frat, J. "Effluents from the Textile Industry". Physique ind. (Broch. 4th Sess. Enseign.-Ind), p. 163-190, 1964. The author discusses the role of the textile industry in the pollution of rivers; the various sources and characteristics of waste waters from different branches of the industry; physical, physico-chemical, and biological methods for treating the waste waters; and economic aspects to be considered in planning a treatment system to meet the regulations imposed by public authorities.

22. Prisley, F. A. "Use of Activated Silica in Water for Textile Finishing". J. Am. Water Works Assoc., 49, p. 459-463, 1957. Activated silica is described. Its use under proper conditions increases speed of formation, as well as size, density, and strength, of the alum floc. The prospect of increasing the density of the floc was the reason for the work described. Cl₂ is used to activate the silica. The floc now settles rapidly.
1. Qasim, S. H. "Industrial Water Softening". Pakistan Textile J., 18, p. 27-30, 1967. Commercial methods of conditioning boiler water via the lime soda, ion exchange and metaphosphate processes are discussed. The article includes a brief description of methods generally used in softening process water especially in the textile industry.
Rao, V. Rama. "Treatment of Wastes from Cotton Textile Industry". Technology (Sindri), Spec. Issue, 3, (4), p. 56-58, 1966. The vol. of waste water discharged from 87 cotton textile mills at Ahmedabad (India) varies between 10,000 and 3,000,000 gal./day. Waste waters are chiefly from bleach and dyehouse and contain fibrous and suspended solids. Owing to great variations in the characteristics of the waste water, it is not appropriate to mix it directly with sewage and to treat them in a combined treatment plant. The modified pretreatment methods of waste treatment in each plant were worked out, which consists of coagulation by lime and gypsum followed sedimentation and filtration through a gypsum filter.


Remy, E. D. and D. T. Lauria. "Disposal of Nylon Wastes". Purdue Univ. Engr., Exptl. Sta., Eng. Bull. 96, p. 596-624, 1958. At the plant of Chemical Strand Corporation near Pensacola, Florida, manufacturing nylon, the waste waters were formerly stored in lagoons and discharged to the Escambia River during periods of high flow. When the plant was expanded, however, treatment of the waste waters became necessary. The more concentrated waste waters were burned to recover heat. Of the remaining waste waters, about 90% come from the manufacture of adipic acid, a principal component of nylon salt. Detailed studies were made on the treatment of these waste waters; the results are discussed, and shown in tables and graphs. It was found that one stream of adipic acid waste was best treated by solvent stripping, using a submerged combustion process. The stripped waste water could then be mixed with the second stream for biological treatment by the activated sludge process. Sedimentation was found to be more effective than flotation for recovery of sludge. Based on the laboratory and pilot-plant studies, a full-scale treatment plant was put in operation in 1957 and has operated efficiently.

Reploh, H. and H. Kustermann. "The Effect of Industrial Effluents on Soil Filtration". Arch. Hvy. Bakteriol, 149, (7/8), p. 627-635, 1965. (In German) Soil filtration of sewage was found to be affected, detrimentally, by textile-mill effluent. Tests showed that the highly alkaline effluent reduced the filtering speed of the soil by dissolving humus substances, but that this could be overcome by neutralizing the effluent with sulfuric acid.

Richardson, R. W. "Supply, Treatment, and Disposal of Water in the Dyehouse". J. Soc. Dyers Colourists, 73, p. 485-491, 1957. An attempt is made to review briefly the many aspects of water - its supply, treatment, and disposal - from the point of view of dyehouse management and the dyer, rather than from that of the water-treatment specialist.
6. Rickles, R. N. "Waste Recovery and Pollution Abatement". Chem. Eng., 72, p. 133-152, 1965. Many waste-recovery methods have been proposed and then rejected because it is cheaper to dump the wastes (thereby polluting the streams and air) than to process them. These recovery processes will make good economic sense, however, when anti-pollution regulations prohibit dumping. 112 refs.

7. Ridgway, F. "Simple Bio-Aeration Kills Strong Wastes Cheaply". Chem. Eng., 70, (40), 1963. Textile mills in the southeast are trying out an attractive biological treatment that can effectively neutralize starch-desizing and other wastes. Developed by H. Souther, it helps textile finishing mills remove up to 95% BOD from streams containing strong starch-desizing wastes.

8. Riemer, H. "New Process for the Treatment of Effluents in the Textile Industry". Z. ges. Textil-Ind., 64, (4), p. 299-304, 1962. (In German) The process, which dispenses with the need for a large storage vessel, and is thus particularly recommended for industrial concerns in highly built-up areas, consists in the addition of a flocculating agent to and intense aeration of the effluent with simultaneous pH correction. This precipitates solid and colloidal impurities as a surface skin which can be easily removed, while residues of dyes, surface-active agents, and organic compounds are removed by adsorption into artificial resins. Typical layouts for the treatment plant are shown and costs are discussed.


10. Rizaev, N. U., P. Kh. Mansurov, Kh. R. Rustamov, and S. U. Nazarov. "The Use of Cation Exchange Resins in Citric Acid Extraction from Cotton Wastes". Izv. Vysshikh Uchebn. Zavedenii, Pishchevaya Tekhnol., (1), p. 174-175, 1965. (In Russian) To increase the citric acid concn. in cotton waste exts., the latter is repeatedly extd. with a 0.43% H2SO4 by using a H cation exchange resin (KU-1, KU-2, and others). After the 1st extn. the liquor contains 78.4 meq. citric acid/l. and is used for further extns. After 3 extns. the concn. rises to 235.0 meq./l. with a simultaneous decrease in the ash content from 222.0 to 13.4 meq./l. (Ca + Mg from 185 to 0.65). The ion exchanger can be regenerated with 2N HCl.

11. Rosenthal, B. L. and J. E. O'Brien. "Bio-Oxidation of Textile-Finishing Waste". Santalki, II, (1), p. 14-18 and 29, 1963. In laboratory studies on the treatment of waste waters from a textile finishing mill by the activated-sludge process, a BOD removal of 84% was achieved. Since the waste water was deficient in nitrogen, supplementary ammonia was added. The density of the sludge simplified disposal, but intense aeration was necessary to keep it in suspension and sedimentation was slow.

and an attempt has been made to establish a purification technique which will treat the effluent to such an extent that final purification may be carried out at the domestic sewage plant. Two purification techniques are suggested: chemical coagulation and adsorption.

13. Rusanovschi, Maria Elena Iliescu, and Bathia Zilberstein. "Physicochemical Characteristics of Residual Waters and Treatment Experiments at a Complex Textile Manufacturer". Ind. Textila (Bucharest), 17, (3), p. 160-165, 1966. (In Rumanian) Studies were carried out in 1965 at the Central Lab. of the Ministry of Light Industry (Bucharest) on residual waters coming from the Buhusi Felt Industry. The total vol. of residual waters is 5,000-6,000 m$^3$/24 hrs. and contains large amts. of residue. This is due to the multiple processes and the variety of raw materials used: vegetal, animal, and synthetic. There are 2 main categories of residual water: (1) coming from the preliminary treatments of the wool and (2) the finishing waters. The former waters are dark colored, contain suspended matter and fats, and have an alk. reaction. They represent 1.3% of the total residual waters, but being the dirtiest they influence the total effluent. They analyze: pH 8.5-10, H$_2$S 42.5-56.1 mg./l., KMnO$_4$ index 3700-4100, and B.O.D. (5-day) 1200-1500 mg./l., total fats 1.9-2.8 g./l. The finishing waters contain dye residues, inorg. salts, detergents, H$_2$S, Cr, etc. The waters from the coloring section represent 57.6% of the total residual water; their characteristics are: pH 7.5, dark in color, H$_2$S 23.4 mg./l., suspended matter (cellulose, short wool fibers) 354 mg./l., low KMnO$_4$ index and B.O.D. (5-day). The overall effluent characteristics are: pH 8-9, dark color, H$_2$S 25-34 mg./l., suspended matter 235-300 mg./l. (org. matter remains suspended), toxic matter such as Cr = 1.7-3 mg./l., and detergents = 11 mg./l. The chem. methods for the treatment of the total residual water are coagulation and adsorption. For coagulation, the following were used: (a) FeSO$_4$, (b) Al$_2$(SO$_4$)$_3$, (c) FeCl$_3$, (d) CaO, and (e) H$_2$SO$_4$. For good results, the optimum amt. of (a) = 1000-1500 and for (d) = 700-1000 mg./l. The sludge resulting from the treatment contains 58% inorg. matter: N 1.4-2.0, K as K$_2$O 3.5-6.3, and P as P$_2$O$_5$ 0.1-0.25%. For adsorption, the following were used: activated charcoal, lignite slag, and residues of ion exchangers. The best results were obtained with activated charcoal. In general, adsorption is too expensive.

14. Rutishauser, Max. "Waste Waters from Cellulose Factories and Their Possible Purification". Ber. Int. Vortragstag. PRO AQUA, Basel, p. 349-355, 1965(Pub. 1966). (In German) Improvements in the utilization of waste waters from cellulose production are described. Thus, the utilization of raw material was increased progressively from 48.5 to 91%, by working-up the fermentable sugars, the yeast-producing waste, and conc. and combustion of the residual sulfate liquor. So far no advances have been possible in the utilization of bleaching waste water.


5. Schmitz, Paul, Karl H. Krueger, Hans Havekoss, and Fritz Steinfatt. "Removal of Formaldehyde from Waste Waters". Farbenfabriken Bayer A.-G. Ger. P. 1,244,144 (Cl. C 07c), July 13, 1967, Appl. Jan. 30, 1964; 3 pages. Acidified (ph <4) waste waters from resin manuf. are freed of HCHO by adding MeOH and heating. One l. of waste water contg. HCHO 4, H2SO4 12, HCO2H 15%, and other org. and inorg. compds. was treated with 50 ml. MeOH and heated. During heating, another 150 ml. of MeOH was added and the vapors were removed through a small column. The residual waste water contained <0.005% HCHO and had substantially less toxicity to Escherichia coli and Daphnia pulex.


9. Sedova, G. P. "Hygienic Aspects of the Treatment of Textile Industry Waste Waters Containing Chromium Salts, Used for Irrigation". J. Hyg. Epidem. Microbiol. Immun., 8, p. 281, 1964; and Zentbl. Bakt. ParasitKde, I, 200, Ref., p. 407, 1965. Details are given of experiments carried out on the treatment of textile industry waste waters containing chromium salts for use in irrigation. Results showed that trivalent and hexavalent chromium, present in clay soil in amounts of 0.1 mg per 100 g of soil, had no adverse effects on the nitrification process. Irrigation with undiluted waste waters containing chromium inhibited the formation of nitrate-nitrogen in the soil but had a growth-promoting effect on plants such as cabbage, carrots, and tomatoes. When using waste waters containing chromium for irrigation, the waste water must be diluted, so that the chromium content does not exceed 0.5 mg per litre and the amount of irrigation should not exceed 2000 m³ per ha.


11. Serkov, A. T., I. N. Kotomina, and V. A. Kolchin. "Recovery of Zinc Sulphate in the Manufacture of High-Tenacity Rayon Cord". Khim. Volokna, (5), p. 30-32, 1962. An economical method for recovering zinc from plasticization and rayon fibre-finishing waste waters, based on the evaporation principle, is described. The process involves counter-current washing of the freshly-formed fibres so that a large proportion of zinc sulphate is removed from the fibres, thus substantially reducing the concentration of zinc sulphate in the plasticization bath and hence reducing the volume of water required for its dilution. The process reduces the loss of zinc sulphate to 0.03 kg per kg of fibres, the bulk of zinc sulphate recovered being returned to the spinning bath. A similar process can be applied to the recovery of zinc from effluents produced during the manufacture of other types of viscose rayon fibres.

12. Sharda, C. P. and K. Manivannan. "Viscose Rayon Factory Wastes and Their Treatment". Technology (Sindri), Spec. Issue, 3, (4), p. 58-60, 1966. The process of viscose rayon manuf. is briefly described. The effluents from the factory are classified as alkali, viscose, acid sulfide, and sanitary. The combined waste treatment may be difficult and sep. treatment is recommended. The process adopted includes neutralization and settlement, incineration, neutralization with lime or limestone and trickling filter. The addnl. problem of Zn removal from viscose tire cord factory is mentioned.


17. Shkorbatova, T. L. and L. D. Pegusova. "Polarographic Determination of Triazine Azo Dyes". Zh. Anal. Khim., 22, (6), p. 918-923, 1967. (In Russian) The polarographic behavior of some triazine azo dyes and amino azo dyes in certain universal buffer solutions (Britton-Robinson) was studied. One of the dyes, Violet 4K, contained Cu and one Cl in the triazine group, all the others belong to the dichlorotriazine dyes. All dyes give polarographic waves in the pH range 2-10. Amino azo dyes and monochlorotriazine azo dyes give 1 wave; dichlorotriazine azo dyes have 2 waves in acid solutions (pH 3). The first wave of all dyes appears in the same range of potentials, -0.3 to -0.43 v.; the appearance of the second wave is connected with the reduction of Cl in residual cyanuric chloride. The height of all polarographic waves of all dyes studied is linearly proportional to the concentration of the substance determined. The above properties can be used for the polarographic determination of dyes in stationary waters and sewage. The absence of a second wave on the polarograms proves that the active dyes are present in sewage in a hydrolyzed state. The accuracy of the method was studied by adding known amounts of dyes. The relative error is ± 2.85%.


19. Sinev, O. P. "Aeration, Settling, and Chlorination of the Combined Waste from a Viscose Fiber Plant". Tr. Novocherk. Politekh. Inst., 162, p. 33-43, 1966. (In Russian) Treatment of waste waters in an aerator (1.1 m.³, height of liquid layer 1 m.) with an air rate of 10-10.4 m.³/m.³ waste water (time 1.1-1.3 hrs.) reduced the CS₂ concn. from 41.6-82.3 to 5.2-9.0 mg./l., and H₂S from 13.7-26 to 1.45-3.1 mg./l. Combined pptn.
of suspended solids at pH > 10 ensured not only intensive floc-
cule formation and pptn. of hydrocellulose but also better con-
ditions for extn. of Zn(OH)₂. Chlorination was most effective
for a supplementary clarification after lime treatment and
removal of suspended solids. The Cl absorbability of the
waste waters after lime treatment, settling, and filtering
through a sand filter was 46-73 mg./l. Residual CS₂ and H₂S
concs. in the waste waters at Cl₂ doses equal to Cl
absorbability were 5.3-12.9 and 0-7.1 mg./l., resp. A
preliminary aeration of the waste waters at pH <3 considerably
reduced Cl absorbability. At a specific air rate in the
aerator of 10 m.³/m.³, the Cl absorbability was ≤30 mg./l.
Chlorination of aerated waste waters ensured complete oxidn.
of H₂S and a decrease in CS₂ concn. to 0.94-2.5 mg./l. and
chem. O demand to 32-60 mg./l.

20. Sinev, O. P. "Role of Hydroxides and Carbonates fn the Floc-
culation and Sedimentation During the Clarification of Sewage
(In Russian) Hydroxides of iron, zinc, and magnesium, and
calcium carbonate are shown to improve flocculation and
sedimentation of hydrated cellulose; optimum pH value is 10.5-
11.5.

contain organic and inorganic substances, and the problems in
various sections of industry must be assessed individually to
ensure treatment which does not contravene the (British) Public
Health Acts or the Rivers (Pollution) Acts. Modern methods and
equipment are discussed in this article.

ment of effluent, oxygen transfer, continuous sludge removal,
flocculation, difficult wastes, and the Lübeck process are
considered. 3 references.

23. Sluchocka, Z. and W. Terpilowska. "The Effect of Aerobic and
Anaerobic Retting on the Quality and Amount of Waste Waters".
Pr. Inst. Wlok. Lykowych, 12, p. 119-140, 1965. Results are
given of pilot-scale and full-scale studies on the volume and
composition of the waste waters from aerobic and anaerobic
retting of flax and hemp. In the aerobic process the 5-day
BOD of the waste waters was found to depend on the acidity of
the liquor. After a single retting the oxygen demand of the
liquor was similar for both processes, but after repeated use
of the liquor the oxygen consumption increased considerably in
the anaerobic process. Aerobic retting increased the con-
centration of total and settleable solids in the waste water.
24. Smallhorst, D. F. "Textile-Waste Treatment in Texas". Am. Dyestuff Reptr., 44, p. 386-389, 1955. This paper presents a brief and condensed report on the activities of the Texas State Department of Health, Engineering Division, in studying the wastes of a textile mill in determining various methods of treating these wastes so as to render them suitable for discharge into the municipal sewage system. This work was done several years ago at the request of the industry since the mill wastes were reportedly having a detrimental effect upon the local domestic sewage treatment plant.


26. Smith, A. L. "Waste Disposal by Textile Plants". J. Water Pollution Control Federation, 37, (11), p. 1607-1613, 1965. Progress made in waste disposal by the textile industry using synthetic fibers is discussed. Characteristics of synthetic textile wastes are tabulated, and some of the waste treatment methods applicable to textile mills are reviewed. Examples of disposal plants and the wastes treated are given. A table shows design and performance specifications on a waste disposal plant for a mill processing synthetic textile fibers.


29. Snyder, D. W. "Cotton Slashing with Synthetic Compounds as a Means Toward Pollution Abatement". Am. Dyestuff Reptr., 44, p. 382-384, 1955. A discussion of the problem of stream pollution resulting from the discharge of process wastes from Crompton-Shenandoah's dyeing and finishing plants and the steps taken toward solving the problem by substituting synthetic...
film-forming compounds for natural sizing materials. The possibility of reducing over-all pollution coming from cotton dyeing and finishing plants by as much as 70% may be possible through auxiliary chemical substitutions.

30. Snyder, D. W. "Dow Surfpac Pilot Study on Textile Waste". Proc. 18th Industr. Waste Conf., Purdue Univ. Engng. Extn. Ser. No. 115, p. 476-482, 1963. At the Waynesboro, Va., plant of Crompton-Shenandoah Co., Inc., manufacturing corduroy, velvets and velveteens, measures have been taken to modify plant processes to reduce the strength of the waste waters, which are discharged to South river, a tributary of the Shenandoah River. In view of the need to reduce the B.O.D. of the effluent still further, various treatment processes were investigated, and pilot-plant studies were made on biological filtration, using synthetic Surfpac medium; results are tabulated, showing that the process was stable to shock loadings and the B.O.D. was reduced by at least 50 per cent. The data obtained have been used to design a full-scale treatment plant which will also have an equalization pond, to permit operation over a 7-day period, and a final sedimentation tank; this should increase the reduction in B.O.D. to 60-70 per cent.


33. Souther, R. H. "Research in Waste Treatment at Southern Mills". Proc. 17th Industr. Waste Conf., Purdue Univ. Engng. Extn. Ser. No. 112, p. 630-636, 1962. The author outlines work which has been done by the textile industry in southern U.S.A. on the control of pollution by reducing the polluting load of the waste waters and developing adequate methods of treatment, and indicates aspects which should be considered in solving a waste treatment problem.


36. Souther, R. H. and T. A. Alspaugh. "Biological Treatment of Mixtures of Highly Alkaline Textile-Mill Waste and Sewage". Am. Dyestuff Reptr., 44, p. 390-395, 1955. Pilot plant studies are being made on the treatment of mixtures of domestic sewage and textile-mill dye and finishing wastes by high-rate trickling filters, by activated sludge, and by chemical treatment to determine the most economical and most efficient method for treating such a mixture. Results indicate that pretreatment through a trickling filter and subsequent treatment through activated sludge is the most efficient method and can be satisfactorily used for treating highly alkaline textile wastes. An usually high removal of BOD and color is obtained. Certain process changes in the plant were also made to reduce the BOD loading through the treatment plant.

37. Souther, R. H. and T. A. Alspaugh. "Biological Treatment of Mixtures of Textile Wastes and Domestic Sewage". Sewage and Ind. Wastes, 28, p. 166-176, 1956. In continuation of pilot-plant studies with experimental percolating filters 1.25 feet in diameter on the treatment of a mixture of sewage and highly alkaline textile waste waters by biological methods, experiments were made to compare the efficiency of three different methods of treatment. The methods investigated were two-stage sedimentation and high-rate biological filtration, single-stage high-rate filtration followed by the activated-sludge process, and a two-stage high-rate filtration followed by the activated sludge process. A mixture of 40% waste water and 60% sewage was used, and applied at rates of 125, 150, 210 and 250 gal/day. The results, which are given in tables, showed that single-stage filtration followed by the activated-sludge process gives an effluent suitable for discharge to a small stream, the reduction in BOD varying from 78% at a rate of flow of 125 gal/day to 66% at a rate of 250 gal/day. Except at a rate of flow of 125 gal/day with a recirculation ratio of 2:1, two-stage filtration and final sedimentation only did not give as satisfactory effluent as single-stage filtration and the activated-sludge process. Two-stage filtration followed by the activated-sludge process gave excellent results, with reductions in BOD varying from 97.4% at a rate of 250 gal/day. Further studies are in progress to compare the efficiency of treatment of mixtures of textile waste waters and sewage without preliminary neutralization of the high pH value and of the waste waters alone after neutralization with acids.

38. Souther, R. H. and T. A. Alspaugh. "Current Research on Textile Waste Treatment". Sewage and Ind. Wastes, 30, p. 992-1011, 1958. This paper covers three phases of the research work at the Cone Mills Laboratory - (1) the various characteristics and polluational effects from cotton processing; (2) research on some of the more practical treatment methods for textile wastes; and (3) the effect of various outside factors on satisfactory biological treatment.

are discussed, including closer control of wet processes, process modification, recovery of usable products for reuse, substitution of low BOD chemicals for higher BOD ones, and good housekeeping practices. Physical, chemical, and biological means of treating textile wastes are also discussed. Tables, 15 references.


41. Souther, R. H. and T. A. Alspaugh. "Treating Textile Wastes Economically". Textile World, 108, p. 137, 1958. Research done at Cone Mills indicates that – (1) Practical to treat mixed domestic sewage and highly alkaline textile waste; (2) Highly alkaline textile-mill waste treated better by trickling filter and activated sludge when in combination with domestic sewage; (3) Combined domestic sewage and highly alkaline textile mill waste through treatment by trickling filter, and aeration process reduction of pollution of effluent enough to be acceptable to a small receiving stream; (4) Combined treatment of sewage and mill waste is preferable to single treatment in two plants because supervision, better and over-all cost less; (5) Some waste-reduction methods given; (6) Strong and weak wastes should be separated; (7) Lagoon, used to reduce BOD, alkalinity, solids and color; (8) Chemical treatment used when biological not practical or economical; (9) The amount of hydroxide alkalinity limiting factor of amount of textile waste that can be treated without pretreatment.

42. Souther, R. H. and T. A. Alspaugh. "Treatment of Mixtures of Textile Waste and Domestic Sewage". Am. Dyestuff Reprtr., 47, p. 480-488, and 490, 1958. This paper is a discussion of research at Cone Mills to evaluate combined treatment against separate treatment with and without pretreatment. The methods investigated include physical, chemical and biological processes, particularly the effect of lagooning as an aid to waste treatment. Conclusions indicated that biological treatment of combined textile waste and domestic sewage without chemical pretreatment is practical and economical.


47. Stafford, W. and AATCC. "Glossary on Waste Treatment and Water Pollution". Am. Dyestuff Rept., 42, p. 695-706, 1953. Terms used in connection with the treatment of waste waters and the pollution of water are defined.


50. Stasiak, Miroslaw. "Biochemical Decomposition of Aniline and Some of Its Derivatives". Gaz, Woda, Tech. Sanit., 41 (8), 1967. (In Polish) PhNH_2, m- and p-NH_2C_6H_4OH, p-NH_2C_6H_4CHO, m- and p-NH_2C_6H_4NO_2, o-NH_2C_6H_4Cl, and p-NH_2C_6H_4SO_3H were subjected to biochemical decomposition controlled by determination of concn. of the initial compds. O, NH_3, and NO_3. Harmful effect of some compds. was studied by determination of B.O.D. The highest rate of decomposition was observed in PhNH_2 and p-aminobenzaldehyde. The decomposition of amino-phenols was much slower, and nitroanilines, chloroaniline, and sulfanilic acid were not decomposed under the experimental conditions. Nitroanilines and sulfanilic acid inhibited the self-purification of anilines.


53. Steele, W. R. "Economical Utilization of Caustic Soda in Cotton Bleacheries". Am. Dyestuff Repr., 51, (1), p. 29-30, 1962. Procedures have been developed for increasing the quantity and concentration of the recovered liquor to permit reuseage of the maximum amount of caustic soda without reconditioning. If the caustic content of the used liquor is not too low, it can be
evaporated, purified and reused. Costs are thus reduced and stream pollution is alleviated. Solvay has also developed a patented flue gas process for reducing both causticity and BOD.


55. Sterbacek, Z., P. Tausk, and J. Trca. "Purification of Waste Waters from Dye Intermediates". Chem. Prumysl., 7, p. 127-130, 1957. Coagulation, adsorption, oxidation, and special chemical treatment were studied for the purification of waste water containing by-products from the production of benzidine and aromatic sulfonic acids. Good results are reported on adsorption with active C possibly combined with previous chlorination, and diazotization and coupling combined with Al sulfate clarification and adsorption on active C. The latter method is considered more economical. No harm is seen to the treated water from a biological point of view.


57. Strasser, P. H. A. "Colloquium on Wool Scouring. Part 5. Detergents - Today and Tomorrow". Textile J. Australia, 40, p. 12-13, 38, and 41-42, 1965. Manufacture, properties, and problems with detergents which have been recommended for wool scouring are covered.


60. Stump, C. W. "Method of and Apparatus for Purifying Sewage". U.S.P. 3,024,189; B.P. 921,407. In the apparatus claimed for the aerobic biological treatment of sewage, there is a tank with two compartments, for treatment and sedimentation, respectively, with a specially-designed hinged opening at the bottom of the dividing wall. The treatment compartment contains a bank of vertical media plates, correctly spaced, with means for aeration at the bottom, giving an upward current of
air between the plates. A conveyor mechanism, with scrapers, removes sludge from the bottom of both sections of the tank, that under the media being carried under the dividing wall through the special opening which prohibits the flow of sewage. Through this same opening, a spray system projects a flow of liquid from the sedimentation chamber into the treatment chamber; this promotes turbulence and seeds the incoming sewage. As the expansion of the media plates would otherwise cause difficulty in their removal for inspection and repair, packing material in the form of inflatable rubber or plastic bags is inserted between the plates and the walls of the tank.


62. Suchecki, S. M. "Water: Industry Challenge - Today". Textile Ind., 130, p. 108-110, 1966. The need for industry to conserve water, use it sensibly, and use it again after suitable treatment is discussed. Dumping of untreated waste or insufficiently treated waste into streams can no longer be tolerated.

63. Summers, T. H. "Effluent Problems and Their Treatment in the Textile Industry". J. Soc. Dyers Colour., 83, (9), p. 373-379, 1967. A lecture dealing with the progress of legislation in the U.K. in regard to prevention of pollution of rivers and local authority sewers, the nature of effluents from the textile industry, detn. of effluent characteristics such as measurement of flow, polluting characteristics of effluents, and the principles of their treatment. The main problems of removal of solids and oxidn. of org. material are discussed. Recent developments by using plastic materials, such as the Flocor pretreatment unit, which have been able to overcome the limiting parameter of overloading of filtration media are pointed out. Results of pilot-scale trials with a Flocor pretreatment unit are given. The possibility of accelerating the process of solid-settling by the addn. of polyelectrolytes, e.g. Alifloc 115X at 1 ppm. concn. is referred to. The installation in the U.K. of a full-scale plant for treatment of wool-scouring liquors by CaCl₂ and recovery of the greases and soaps by a precoated rotary vacuum filter are discussed. Methods for the neutralization of effluents, redn. in the concn. of detergents in effluents, removal of color and the segregation of effluents from bleaching and kier-boiling are discussed. The necessity for devising new processes for effluent treatment from newer types of textile processing is indicated.


2. Tanaka, M. and others. "Biological Treatment of Wool Finishing Waste". Kogyo Kagaku Zasshi, 67, (5), p. 770-776, 1964. (In Japanese) (English Summary) The method recommended is to treat wool scouring waste by thermophilic methane fermentation, to mix this fluid and other wastes (i.e., from dyeing) temporarily in a lagoon, and then to treat it by the activated-sludge process. The results of a successful industrial trial are reported.


4. Tarcsay, F. "Questions on Waste Waters from the Textile Industry". Wasser U. Boden, 18, p. 276-280, 1966. (In German) Textile industry waste waters containing acids, alkalies, dyes and fibers have a high oxygen demand, and therefore require preliminary treatment. Details are given of laboratory and pilot-plant experiments which have to be carried out by the textile industry in planning the treatment necessary before the waste waters can be discharged to the municipal sewer to reduce the polluting load.


6. Taylor, Worthen H. "Treatment of Wool Scouring Wastes". Sanitalk, 1, p. 13-14, 1952. This article relates to the treatment of wool scouring wastes by the addition of CaCl₂ and centrifuging in a sharples DG-2 centrifuge. This method resulted in a reduction of the fats, turbidity, and suspended solids by 98-99 percent. The amount of CaCl₂ used varied from 0.25 to 1.5 percent of the total weight of the wastes treated, the amount depending on the concentration of the wastes. However, wool scouring wastes resulting from the use of a minimum quantity of water in scouring required less chemicals. The success of the process is adding the solution of CaCl₂ three seconds before centrifuging and then holding the effluent in a skimming tank from 20 to 30 minutes. Temperature had little effect upon the process.

8. Tobola, Stanislaw. "Problems of Technological Wastes in Chemical Industry". Chemik (Gliwice), 18, p. 121-124, 1965. (In Polish) Technological wastes should be utilized either by reprocessing or by application to other industrial uses. Wastes of synthetic plastics should be cleaned, comminuted, washed, segregated, chem. dissolved, hydrolyzed, polymerized or depolymerized, etc. Rubber wastes must be divided into unvulcanized and vulcanized wastes and processed accordingly. The wastes from synthetic fibers industry must be divided into wastes from synthetic fibers plants, from garment and other plants, and from consumers of these products. Wastes from chem. plants (different metals, their salts, and oxides, alkalies, acids, alcs., polymers, gases, etc.) and from petroleum refineries are also discussed.


2. Vasil'ev, G. V. "Purification of Waste Waters from Dyeing and Finishing Factories". Tekstil. Prom., 26, (7), p. 52-54, 1966. (In Russian) Problems associated with the ever-increasing use of new dyes, synthetic surface-active agents which cause excessive foaming, and of finishing agents such as dodecylbenzenesulphonate, certain cationic agents, and Karbozolin which can be oxidized biochemically to only a small extent and are toxic to microflora used in effluent purification, are discussed.


4. Vasil'ev, G. V. "Purification of Waste Waters of Textile Factories". Ochistka Prom. Stochnykh Vod, Akad. Stroit.i. Arkhitekt. U.S.S.R., Vses. Nauchn.-Issled. Inst. Vodosnabzh., Kanaliz., Gidrotekhn. Sooruzhenii i Inzh. Gidrogeol., Tr. Soveshch., Moscow, 1958, p. 188-202, (Published 1960). Characteristic water contaminants from fiber and textile processing, methods of water treatment, and tolerances of contamination are described. Water from the primary processing of linen fibers contains organic compounds, K, Ca, phosphates, and sometimes alkalis, acids, and detergents. Wool scouring contaminates the water with soap, Na2CO3, and wool fat, which is extracted for the production of lanolin. Silk reeling causes biological contamination; spinning and weaving results in pollution with olein, oil, synthetic compounds, and starch; waste water from dyeing and bleaching contains dyes, salts, acids, alkalis, soap, detergents, Cu, Cr, and various organic compounds. Tables of waste-water experiments and ratios of production waste water are given. Tolerable amounts of contaminations and required characteristics of waste water are: pH 7 → 8.5, temperature 10-25°, BOD for biological filters 500-800 mg/l, BOD for aeration tanks 500-1,000 mg/l, etc. Dilution with city sewage is recommended if necessary; mixing with 25% sewage and treatment on biological filters decreases the coloration of water from dyeing with sulfur dyes, lowering the BOD 65 → 90%.

5. Veir, Byron B. "Celanese Deep Well Disposal Practices". Ind., Water Waste Conf., Proc., 7th, Austin, Tex., p. III-25 – III-36, 1967. Plant waste characteristics, lab. testing of wastes, selection of a waste disposal system, and waste treatment are discussed. The treatment system consists of a waste neutralization tank, a gravity settling tank, filter feed pumps, Anthrafil bed filters, cartridge filters, and a high-pressure injection pump. A 200-ft. blanket of highly permeable sand strata located at a depth of approx. 3500 ft. is suitable for deep well waste disposal. Results of the study indicate that deep well disposal is feasible for the plant.

- oxidizability: 133.8,
- 5-day B.O.D.: 198.2,
- NH3 N: 16.5,
- NO3 N: 0.21,
- NO2 N: 0.0,
- Cl-: 188.4,
- SO4--: 209.6,
- PO4 3-: 2.8,
- Cr: 0.01,
- solid residue: 484,
- suspended solids: 89.7,
- coli titer: 0.001-0.0004,
- coli bacteria: 1,647,000 in 1 ml.

In the summer the sewage is used to irrigate gardens; in the winter it is discarded into the river. Nitrification and self-clarification of soil irrigated with this sewage were very active. Under natural conditions, nitrification and oxidation of organic substances took place intensively during the growing season. By the end of the growing season the coli titer in the lower horizon had decreased from 0.01 to 0.0001. Vegetables grown on gardens irrigated with the sewage developed normally and in organoleptic indexes did not differ from vegetables irrigated with impound water. Vegetables in contact with the sewage had a coli titer of up to 0.00001; for those having no contact it was ≥ 0.1.


8. Vogel, W. "Treatment and Disposal of the Sludge in Waste-Water Treatments". Melliand Textilber., 48, (8), p. 950-954, 1967. (In German) Sludge from textile effluent has a high water content, and before disposal must be treated to separate this water. Equipment for various methods of sludge treatment is reviewed. The methods include rotting and stabilizing, static and dynamic water separation, drying, combustion, and conversion to compost.


2. Waddington, A. H. "The Practical Treatment of Liquid Wastes". Effl. Wat. Treat. J., 4, p. 179 and 181, 1964. There are many practical methods by which suspended solids and biological oxygen demand can be reduced for disposal to water courses. However, it would and will have to be the object of all methods of waste treatment to render such waste liquors suitable for reuse. The reclamation of these large volumes of various polluted liquors is necessary to the economy of this (England) and of many other countries. The newly developing countries especially present an opportunity to install and develop an economical water reclamation system which could be made self-supporting.


11. Williams, S. W. and G. A. Hutto. "Treatment of Textile Mill Wastes in Aerated Lagoons". Proc. 16th Industr. Waste Conf., Purdue Univ. Engr. Ext. Ser. No. 109, p. 518-529, 1961. The authors describe pilot-plant studies on treatment of waste waters from two textile mills of Burlington Industries, Inc. The plant at Mooresville, North Carolina, is an integrated cotton textile mill; various process modifications were made to reduce the volume strength of the waste waters, including installation of a caustic recovery unit and use of CMC instead of starch. Pilot-plant studies on treatment of the waste waters by chemical coagulation, biological filtration, and lagooning showed that good results could be obtained in aerated lagoons, and full-scale plant is being constructed; it will consist of two aerated lagoons with detention periods of 48 hours, and two sedimentation lagoons with detention periods of 12 hours with provision for recirculation of effluent if required. Sludge from the lagoons will be discharged to the municipal sewers. Foaming in the aerated lagoons will be controlled by addition of antifoaming agents, but sprays can be installed later if required. The mill at Wake Forest, North Carolina, receives synthetic fabrics from other mills for dyeing and finishing. In view of the successful results obtained with the aerated lagoons at the Mooresville plant, similar pilot-plant lagoons have been constructed at Wake Forest and are giving good results, with reductions in BOD of 75-80%.

12. Wilroy, R. D. "Industrial Wastes from Scouring Rug Wools and the Removal of Dieldrin". Proc. 18th Ind. Waste Conf., Purdue Univ., Engr. Ext. Ser. No. 115, p. 413-417, 1963. When it was planned to construct a rug manufacturing plant in southeast USA, detailed studies were made on the composition of the waste waters, the condition of the receiving stream, and the best type of treatment. The coarse heavy wool used in weaving rugs has a high concentration of grit and inorganic suspended solids and a low initial grease content. It was learned that the waste waters
would also contain large amounts of dieldrin, used for moth-proofing the wool, and there would also be waste waters from the dyeing process. The treatment facilities constructed consisted of fine screens, a sedimentation tank, and a baffled equalization lagoon to provide a long detention period with automatic discharge of the effluent at a rate proportional to the flow in the river. Waste waters from the dyeing process are discharged to a small creek flowing into the river, except when the dyeing processes are deep red and black dyes are to be dumped, when the waste water is diverted to the lagoon. Effluent from the septic tank treating sanitary sewage is also discharged to the lagoon. Although the lagoon was designed only for equalization, there is evidence that active anaerobic decomposition is occurring, with reductions in BOD of 80-90%. The concentration of dieldrin in the final effluent is about 0.25 mg./l, and when diluted with river water this should be reduced to 0.0005 mg./l, which is much less than the mean tolerance limit for the fish in the river. Some difficulty was experienced in dewatering the sludge on the sand beds, since the very fine wool and grease form an impervious layer on top of the sand and excess water collects on top of this. At present, the excess water is removed by pumping and the sludge dries rapidly. Dewatering system to be installed.


14. Wincor, W. "Water in the Textile Industry". Melliand Textilber. 43, (1), p. 81-83, and (2), p. 189-193, 1962. Sources and qualities of water are surveyed, the deleterious effects of Ca, Mg, Fe, and Mn salts are discussed, the role of micro-organisms is examined, and methods of purification are described.


16. Wittman, J. "Effluent Purification of a Bleaching and Dyeing Plant". Melliand Textilber., 38, (6), p. 679-680, 1957. After a discussion of the problems of treatment of industrial waste waters, a process is described for the treatment of waste waters from bleaching and dyeing. The process is based on chemical precipitation by metallic iron in the form of waste filings which are stirred, with aeration, with the waste waters in a concrete-covered tank.


can pick up rapidly from iron pipes. The exchangers are soon clogged by iron hydroxides, however. Ca and Mg can be removed more economically than iron by means of ion-exchangers. The use of Levatet in producing bicarbonate-free water for acid dyeing of wool is discussed. Finally, the removal of organic (humic) acid from water is shown to cost less when ion exchanger methods are used as compared with flocculation and flotation techniques.

19. Wuhrmann, K. "Effluent Purification with Particular Reference to Phosphate Elimination". SVF Fachorgan Textilver., 20, (7), p. 432-441, 1965. (In German) Nitrogen and phosphorus are both part of the nutrient matter for microphyte organisms which multiply rapidly in effluent liquor. Methods for clearing nitrogen- and phosphorus-containing solutes from the effluent are described, and the records of one plant are discussed.
1. Yakovler, S. V., Yu. M. Laskov, and Yu-Lin Yo. "The Effect of Surface-Active Agents on the Biochemical Purification of Effluents from Textile Mills". Vodosnabzh i Sanit. Tekhn. (9), p. 12-14, 1963. As a result of widespread use of surface-active agents (I) in the textile industry, the effluents from textile mills contain 50-125 mg/l of such agents, and higher concentrations can be expected in the future. The effect of I on the biochemical purification of effluents was studied in laboratory models of aeration tanks. The experiments were conducted on effluents from a textile printing plant to which various amounts of the most widely used I (Sulfanoles) were added, and on effluents from a cotton-manufacturing mill, containing I in a total concentration of 60-130 mg/l. As determined by the reduction of BOD and organic chemicals demand the addition of 20 mg/l of sulfanoles had no significant effect on the biochemical purification process. Higher concentrations substantially reduced the purification efficiency. In experiments with the cotton-mill effluents, satisfactory purification was obtained when the effluents were diluted with 40-100% domestic sewage, the needed amount of the diluent being determined by the nature and concentration of I, their maximum permissible concentration for effective purification ranged from 35 to 70 mg/l.
1. Zakharina, S. B. "Combined Clarification of Waste Waters and Ventilation Exhausts in Viscose Fiber Production". Mater. Soveshch. Molodykh Spets. Vses. Nauch.-Issled. Inst. Vodosnabzh., Kanaliz., Gidrotekh. Sooruzhemi Inzh. Gidrogeol., p. 79-83, 1966. (In Russian) A process for clarification of waste waters and ventilation exhausts was developed. The latter, contg. H2S, enter a hollow steel scrubber wet with a soln. of calcined soda (30-75 g./l.). The time of residence of the gases in the scrubber is 15 sec.; the reflux rate with the fresh soda soln. is 2 m.3/m.2-hr.; total reflux rate with recirculation of the soda soln. is ≥7 m.3/m.2-hr.; the absorption coeff. 1500 mg./m.3-hr.-torr. The purified gases contg. ≤20 mg. H2S/m.3 are released into the atm. Waste waters contg. ZnSO4 and H2SO4 entered a mixer where the pH is brought to 4-5 with a soda-sulfide soln. To remove CO2 formed the waste waters are passed to a packed degasification column to which air is fed (0.2 m./sec.). The reflux rate is 80-100 m.3/m.2-hr. ZnS is removed, dehydrated in a vacuum filter, and calcined in the presence of atm. O (sulfatizing calcination furnace) to obtain ZnSO4.


3. Zawadzki, Jerzy. "Biological Purification of Production Effluents From Cotton Bleaching". Biul. Inst. Wlok., 17, (2), p. 1-5, 1965. (In Polish) Investigations were made on a lab. scale on the possibility of purifying waste waters from cotton bleaching for further utilization. The av. content of 5-day B.O.D. in effluents was 219.2 mg. O/1. Purifications were carried out by the activated sludge method. Redn. of 5-day B.O.D. was achieved at 20° in the range of 84-8% and the oxidizability was 70-80%. To ensure the development of microorganisms, addn. of mineral nutrients was necessary in min. amts. of 1 g. K, P, and N (in form of NH3)/m.3 of effluents. It was impossible to det. on the lab. scale the optimum amt. of air needed for decreasing 5-day B.O.D. in effluents. The purified waste waters could be reused for rinsing raw cotton after bleaching.

4. Zhelobetskaya, M. F. "The Use of Spent Sulphite Liquor Extract for Sizing Flax Warp Yarn". Text. Ind., Moscow, 22, (8), p. 48-49, 1962. Spent sulphite liquor extract has been used successfully as a partial replacement for starch in flax yarn sizing mixtures. The warp threads are sized by the normal procedure with a mixture containing starch, chloramine, spent sulfite liquor extract, surface-active agent, soap and water,
sodium silicate, glycerol, cotton seed oil and sulfanol are omitted from the mixture. After sizing, the yarn is soft and dries more rapidly. The yellow color of the yarn disappears completely during finishing operations.

5. Zimmerman, H. "Biodegradable Detergents". Can. Textile J., 82, p. 43-45, 1965. Some of the problems of textile mill waste disposal are outlined and the impact of biodegradable detergents on such problems is discussed. The chemistry of detergents is reviewed briefly.

6. Zimmerman, F. J. "New Waste Disposal Process". Chem. Engr., 65, (17), p. 117-120, 1958. This process involves the wet combustion of the organic matter of the waste at very high pressure and high temperature. The organic matter is oxidized to carbon dioxide and an effluent containing only harmless mineral matter is produced. Sufficient heat is generated by the oxidation to the reaction to proceed without external sources of heat once initial heating has started the reaction. The surplus steam can be used for power. This process is useful for strong and difficult organic wastes and for sludges.