SUMMARY REPORT

RECOVERY OF WARP SIZES

Project A-016-NC
March 1, 1966 - June 30, 1966

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SUMMARY REPORT - WATER RESOURCES RESEARCH PROJECT NUMBER A-016-NC.

Time period covered by Project: March 1, 1966 through June 30, 1966

In the first part of this report period (July 1, 1965 through June 30, 1966) two projects were active. One involved a survey of the literature on stream-pollution by textile wastes and the other was a study of the feasibility of warp-size recovery.

The literature search revealed 308 articles, many of which contained other references, on the subject of textile wastes of one kind or another as a contributor to water pollution. Abstracts were made and for future convenience were coded and placed on computer cards. The abstracts were then indexed under 164 pollution-type groupings and 111 literature-source groups, 40 of which were foreign publications. An annotated bibliography was prepared; a copy is attached to this report.

A common first operation in the preparation of cloth for dyeing and finishing is desizing, a process that removes the material added to warp yarns to make the weaving of the fabric possible. Rather large quantities of material are involved (sometimes as high as 20 per cent of the weight of the cloth) and since they are usually biodegradable, contribute greatly toward stream pollution when present in the effluent from the finishing plant. As much as 60 per cent of the total biological oxygen demand of streams accepting finishing plant wastes may be assigned to warp sizes. A possible way to alleviate this situation is to recover the warp size from the desizing medium and dispose of it as a solid material; or, if possible, reuse it as a warp size. Thus, it appeared desirable to investigate the feasibility of the recovery and reuse of such materials.

The approach to this problem was to dissolve the size from the warp in the least amount of water possible and to use this solution as the base for a further sizing formulation. Carboxymethylcellulose (CMC) was used for this project. From a series of experiments it was found possible to remove from the sized warp one-third of the CMC applied. Under the conditions used, a 2% water solution was obtained. A new formulation was prepared from this solution by adding a suitable amount of CMC and when applied to warps was found to give a satisfactory performance. In the initial experiments grey cotton yarns were used for the warps, and in desizing, water-soluble waxes and pectins were
also removed. These caused a problem because they decomposed readily giving an offensive odor to the size solution.

The results of research during the past few months has provided a method of eliminating the non-cotton, water-soluble materials from the sized yarns. The warps were passed through a bath of boiling water and squeezed before passing into the size bath. Although the yarns treated in this way contained about 70% moisture when they were sized, they picked up sufficient CMC so that they performed satisfactory on the testing equipment. The water solution obtained from desizing these warps did not develop the offensive odor of the previous experiments. The fact that this procedure did not require the drying step before the final size application makes this procedure commercially feasible. Moreover, more efficient methods for the recovery of the size can be used, and will be investigated.

A paper was presented at the Water Resources and Pollution Control Conference at North Carolina State University at Raleigh on April 6-8, 1966 entitled "Recoverable Warp Sizes - A Feasibility Study", by Mr. R. N. Berrier. A detailed summary of the paper is attached.

Research plans are being considered to carry this project further by the use of size materials which can be readily removed from the warps with hot water then precipitated either by addition of a chemical or by change in the acidity of alkalinity of the solutions. This procedure offers the possibility of redissolving the size for further use. Several manufacturers are working on the production of suitable materials in this category, and are optimistic that they will be in position to submit samples for test in the near future.

H. Y. Jennings
Principal Investigator

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July 15, 1966
RECOVERABLE WARP SIZES – A FEASIBILITY STUDY

by

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Objectives

1. To survey the literature on stream pollution by textile wastes.

2. To examine the possibilities of recovery of existing sizes and also to consult with manufacturers of sizing materials and textile mills on the feasibility of such a procedure.

The survey of the literature on stream pollution by textile wastes was completed. Three hundred and eight articles, many of which give other references, were abstracted, coded and placed on computer cards. These articles were indexed under 164 pollution-type groupings and 111 literature-source groups, 40 of which were foreign publications. (See annotated bibliography attached as part of this report).

Size Manufacturers

Twelve of the most important size manufacturers in the United States were contacted on the concept of a recoverable and reusable size material. Four of these companies produce starch or a modified starch size and all stated they had nothing to contribute to such a program. Four were interested in the program and were doing research on materials which might have such a potential end-use. Four had materials which were water soluble and could be used for such a project. The last group expressed a willingness to cooperate by supplying materials for such a project; in fact, one of these companies actively participated in the limited series of experiments which were conducted under this project.

Textile Mills and Finishing Plants

The conferences with and communications from members of this group varied depending on their present situation as follows:

1. The plants using starch size could not visualize any way of reclaiming starch size after it was removed from the fabric.

2. Textile companies that had replaced starch with synthetic sizes with low B.O.D. properties were having no problem with water resources authorities at present but were interested in a method of recovery of these more expensive synthetic size materials if the process was commercially and economically practical.

3. Textile mills that had gone to the expense of installing a water purification plant for their effluent were not interested in a project of this type since they could use low priced sizing materials even though they were high in B.O.D. and pollution properties.

4. Textile weaving and finishing plants using only synthetic fibers and fabrics took the position that their volume of sizing materials was so small that they did not need to be considered as a serious problem.

The general conclusion from these contacts was that most of this group were not particularly interested in this project unless their product, their process, their location or a water resources authority forced them to take action.
Desizing and Recovery Experiments

A fabric sized commercially with carboxymethylcellulose (CMC) was used for this experimental work. A series of experiments were made varying temperatures, ratio of water to fabric and the number of times the fabric was immersed and squeezed. The greater the ratio of water to fabric and the higher the temperature the greater the percent of size removed but the lower the concentration of size in the water. It was found that if a ratio of water to fabric by weight was 2 to 1 and it was processed at 200°F through the laboratory pad ten times, that 3.6% solids could be obtained in the desizing solutions. However, by preliminary experiments on grey yarn it was determined that about 50% of these solids were non-cotton materials on the grey yarn or about 30% of the CMC was recovered in the solution.

This solution was then made up to 6% solids by adding CMC (2% of CMC added) and used in sizing yarns. This sized yarn tested on the shed-tester had 3 breaks and 6% shed compared with a yarn sized with 6-3/4% CMC which gave no breaks and 3-3/4% shed under the same test conditions. The reclaimed solution should have about 4-1/2% CMC added to compare with the regular CMC treated yarn. None of the reclaimed solution was available for a repeat experiment.

The non-cotton content of the desizing solution was a handicap due to the fact it decomposed very rapidly and produced an obnoxious odor. This could be controlled by adding a preservative but would add to the cost of recovery. CMC cannot be precipitated readily by a pH change which eliminated the possibility of removing it at a low cost by precipitation.

Although this was a very limited series of experiments the following comments are made:

1. It would appear that about one-half of the CMC could be recovered in solution if the ratio of water to CMC was about 2 to 1 by weight and the temperature of the solution was held at about 200°F. Much higher ratios of water to size are used commercially but a lower volume would be feasible if a high-priced size were being used.

2. In these experiments the samples of fabric were re-run through the same solution; if a counter water flow could have been used the percent recovery would have been considerably increased. A series of immersions and squeezes are used commercially in processing so that this procedure would be practical.

3. In cotton processing, the non-cotton ingredients presented a definite problem. Sizing manufacturers are working on sizes which will precipitate or dissolve by varying the pH which might be a solution to this problem.

Observations

1. There are several synthetic sizing materials which are water soluble and fairly expensive that should be investigated as a reusable and sizing material. However, such an investigation would involve considerable experimental work checking optimum operating conditions and the most
efficient type of processing equipment which could be adapted commercially. Several size manufacturers are working on materials which would fit into such a program but none of these companies indicate a desire to develop the procedure necessary to carry the development through to commercial usage.

2. Since several finishing plants have found by investigation that over 50% of their stream pollution, especially B.O.D., originates in their desizing operation, this is an important field for further investigation. Such an investigation could include a search for textile finishing auxiliaries which would function as required but would also lower pollution as compared with materials now in use.

3. The textile finishing plant management has the choice of two alternatives regarding stream pollution, faced with the increasing pressure both from local and federal governments. They can follow the direction suggested in this project of actively following every lead to diminish the amount of pollution in the plant effluent or they can install a purification system and place all of their research efforts in making this system efficient and economical.

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