It is a well-known fact that when fibrous materials, such as textile fibres, paper, leather and the like are treated with aqueous liquids, the physical behavior of the baths with regard to the fibrous substances is greatly influenced by the composition of the said baths. It is possible to alter the rate of speed with which the liquid is absorbed by the material to be treated, by means of relatively small additions, for example by the use of wetting agents or by the addition of glue, gelatine or the like.

According to the present invention it is also possible to influence the progress of the treatment with aqueous baths in a different manner, i.e., by previously changing the rate of speed with which the walls of the fibres will swell up. This swelling rate may either be increased or reduced, and in this manner it will be possible to influence the progress of the treatment (which, of course also dependent on the composition of the treating bath and the nature of the fibres) in a given sense.

If one has to do e.g. with fibres having a high-swelling rate and a treating liquid which is a comparatively poor wetting agent, the wetting of the fibres may proceed very slowly. This will be of importance, if it is desired to clean the outside of the fibre, or to subject the same to some other treatment while keeping the inner surface out of contact with the treating bath as much as possible, e.g. when cleaning absorptive materials dyed with colors that are very apt to run.

If, on the contrary, I have to do with fibres having a low swelling rate and a liquid with a high penetrating power, the treating bath will penetrate very deeply into the interior of the fibres and exert its action there. This is important, e.g. when cleaning fibres into which impurities have entered very deeply, and also when subjecting dyed materials to a subsequent soap bath.

In order to improve the results of a treatment with a given kind of bath, it may therefore be important either to increase or to reduce the speed with which the fibres will swell. This purpose may be obtained in different manners.

A very valuable method for varying the swelling rate in drying the fibres preferably to below the moisture content of the air-dry material, after which it is allowed to absorb moisture again until the desired wetting speed has been attained. In general the swelling rate is promoted by drying the material, and again reduced by the subsequent absorption of water. It is possible in this manner to impart to the fibres a given wetting speed which may be either lower or higher than the wetting speed of the ordinary air-dry material.

If the fibrous material is dried practically completely and subjected to the treatment in the bath in this condition, the wetting speed is practically at a minimum. This may be advantageous in certain cases and in those cases the material after drying is not allowed to absorb any more water vapor, so that the pre-treatment only consists in an intensive drying process.

If the fibrous material is not completely dried, or if the dried fibrous material is allowed to absorb water vapor again, the wetting speed will be increased. In this manner it is possible to increase the wetting speed to an optimum value, for which purpose the water content as a rule will have to be raised above the water content of the air-dry material.

It is a very surprising fact that with the products thus treated the wetting speed does not depend exclusively on the final moisture content, but also on the manner in which this final content is obtained. If an air-dry material is dried still further and subsequently allowed to absorb water vapor again until the original moisture content has been attained, the wetting speed generally will have a value different from that of the starting product.

The result obtained may still be improved, if after drying and wetting the material, it is dried, and, contingently, wetted again and so on. It was found that a fibrous material obtained according to this method, with a given moisture content, will have a wetting speed different from the wetting speed obtained if the treatment has been applied only once. By the said alternating pre-treatment the materials (particularly cotton) are "activated," which is shown, e.g., by the great rate of speed at which fibrous materials of this kind will absorb dye stuffs.

The swelling rate may also be varied by causing the fibres to absorb substances in a gaseous form, which naturally do not occur in the fibres. In general such substances will reduce the swelling rate; in some cases, however, there will be an increase of the swelling. Substances which when in gaseous form are adapted to vary the swelling rate, are amongst others:

- Alcohols which may belong either to the higher or to the lower alcohols and which may be either primary, secondary or tertiary, aliphatic, aliphylhydric, aromatic, saturated or unsaturated and monohydric, or polyhydric.
- Hydrocarbons which also may either be all-
phatic or aromatic and saturated or unsaturated, e. g. terpenes, Halogenated hydrocarbons, Aildehyde and ketones (which under certain conditions can increase the swelling rate), Carbon bisulphide, Volatile and liquid esters and ethers, Fatty acids, Hydroxy amines (which likewise may increase the swelling speed), Sulphur dioxide.

The above mentioned substances will act differently on the kind of fibres than on another kind. A substance which will increase the swelling rate of cellulose fibres may have the reverse effect on animal fibres. It also occurs that a substance is apparently indifferent to one kind of fibres, but has a marked influence on other fibres.

Both air-dry fibres and fibres having a reduced or increased moisture content may be subjected to this pre-treatment with gaseous materials.

The above mentioned substances not naturally present in the fibres may also be introduced into the said fibres by spraying or impregnating the same with those substances, if desired in the shape of emulsions or solutions. The fibrous material thus treated in some cases may be immersed into the treating bath at once; if the dissolved or emulsified substance is not volatile or only slightly volatile, one may also dry the pre-treated material first and then subject the same to the action of the treating bath.

Suitable non-volatile substances are e. g. soaps, both acid and neutral ones, sulphonated fatty acids, alcohols and other wetting agents, such as e. g. alkylated naphthalene sulphonlic acids and cumol sulphonlic acid, primary, secondary or tertiary higher alcohols, higher amines and hydroxy amines and compounds of the same with acids.

The materials sprayed or impregnated with a solution or an emulsion of the said substances are preferably dried and subsequently treated, if desired, with moist air or with a gaseous substance increasing the swelling rate. By this pre-treatment the fibrous material may either be activated or not. The material thus pre-treated may then be introduced into the treating bath proper.

It is also possible to apply more than one of the methods indicated above, as already described with regard to the pre-treatment with non-volatile substances. For example, the pre-treatment by means of drying and subsequent absorption of water vapor may be very well combined with a pre-treatment with other substances in a gaseous form. All treatments, moreover, may be repeated once or several times.

Suitable textile fibres for the processes described are cellulose fibres, such as cotton, artificial silk, jute and linen. Besides these vegetable fibres, animal fibres, such as wool may also be treated according to the invention. The fibres may be pre-treated either in their native state, or in a cleansed, worked or partly processed condition, e. g. after bleaching, mercerising or drying.

The process will now be illustrated with regard to the following examples.

Example 1

Bleached cotton is dried on drying drums, cooled and exposed to damp cold air until the submersion time of a sample in distilled water has been reduced to 70 seconds. Submersion of the material when dried on drying drums and not moistened again was 92 seconds.

Example 2

The cotton treated according to Example 1 is further left in contact with cold, damp air until the submersion time is reduced to 54 seconds.

Example 3

A dried, air-dry fabric is dried in hot air, until the moisture still present is entirely or almost entirely evaporated. The material thus dried is subjected at room temperature to the desired treatment, e. g. a treatment with a soap-solution.

Example 4

A cotton fabric is boiled, bleached and rinsed under pressure in the known manner, the wet material is dried either on drying drums, or in some other manner, e. g. on a stretching frame, in a drying chamber or the like.

After drying the fabric is cooled and subsequently exposed to damp air, e. g. during a period of 10 minutes. The fabric is then once more dried by means of dry air for some time, e. g. 30 minutes, and the alternate treatment with damp and dry air is repeated several times. The treatment may be stopped at will either in the damp or in the dry stage and at any moisture content desired.

In this condition the cotton is “activated”; the activated cotton in a subsequent treating process, e. g. in a dyeing or mercerising bath, will give more uniform results than the cotton not pre-treated.

The material pre-treated in this manner will also receive printing and sometimes even the finish, more readly. When the material is dyed, e. g. with direct dyestuffs, the colour of the activated cotton after a predetermined period of drying (if not too prolonged) will be darker than that of the non-activated cotton after the same time.

In general both the damp and the dry air should not be too hot, i. e. they should not exceed a temperature of 60° C. Preferably a temperature similar to that of the atmosphere, e. g. 15° C is chosen. The hot and the dry air may also be of different temperatures, in which case the dry air generally will have the higher temperature. If needed the fibrous material thus pre-treated may be kept for a certain length of time before it is subjected to further treatment.

Example 5

Dried cotton is exposed to vapors of amyl alcohol which are partly absorbed by the cotton. The time needed for wetting the material, expressed as the submersion in time, which was 22 seconds for the dried material, is reduced to 5½ seconds after absorption of the amyl alcohol.

Instead of amyl alcohol, other alcohols, benzene, carbon disulphide, carbon tetrachloride and the like may be employed. A similar effect may also be obtained with vapors of dilute ammonia, and instead of dried cotton air-dry cotton may also be used.

Example 6

Dried cotton is exposed in the manner described in Example 5 to the vapors of a solution of formaldehyde in alcohol. After the equilibrium between the fibrous material and the vapour atmosphere has been established, the wetting speed amounts to about 18 seconds.
Example 7
Dried cotton which has been either previously subjected to some improving treatment or not, is exposed to dry ammonia gas which is absorbed by the fibres. The material thus treated will be wetted out far more slowly than the untreated material.

Example 8
Dry cotton is sprayed with amyl alcohol, until the increase in weight amounts to about 5%. The fabric is then left to itself for some time and subsequently subjected to the action of the desired treating bath.

Example 9
Air-dry cotton is sprayed with an emulsion of carbon tetrachloride in water and subsequently left to itself for some time, the carbon tetrachloride and the water evaporating again.

Example 10
A cotton fabric is immersed in a solution of elaidin soap containing 5 grams of fatty acid per litre, subsequently dried and activated by an alternating treatment with damp and dry air. The material thus treated will accept dyes very quickly.

Example 11
Cotton dyed with indigo, which has not been treated with soap after the dyeing bath proper, is immersed in a solution of elaidin soap or marseille soap and subsequently dried. The fabric may now be immersed in water, subsequently treated in a similar way as in a soap bath without, however, adding soap, and rinsed.

If desired, the dried soap containing fabric may be exposed to damp air or activated. The fabric may also be pre-treated with some other gaseous substance which has an influence on the swelling rate.

The final soaking process will be far more intensive in the manner described above than when carried out immediately after dyeing.

I claim:
1. A process of increasing the wetting properties of organic fibrous materials prior to subjecting the said materials to a treatment in an aqueous bath, comprising modifying the swelling rate of the wall of the fibers by repeatedly alternately drying the material and humidifying with water vapor the material at a temperature not exceeding 60° C. until the material shows increased wettabiliy.

2. A process of increasing the wetting properties of organic fibrous materials prior to subjecting the said materials to a treatment in an aqueous bath, comprising modifying the swelling rate of the wall of the fibers by repeatedly alternately drying the material at a temperature not exceeding 60° C. and humidifying the material by means of water vapor at a temperature not exceeding 60° C. until the material shows increased wettabiliy.

3. A process of increasing the wetting properties of organic fibrous materials prior to subjecting the said materials to a treatment in an aqueous bath, comprising modifying the swelling rate of the wall of the fibers by repeatedly alternately drying the material and humidifying the material by means of water vapor at a temperature not exceeding 60° C. until the material shows increased wettabiliy, said material being humidified to a moisture content exceeding that of the air dry material.

4. A process of increasing the wetting properties of organic fibrous materials prior to subjecting the said materials to a treatment in an aqueous bath, comprising modifying the swelling rate of the wall of the fibers by repeatedly alternately drying the material and humidifying the material at a temperature not exceeding 60° C., until the material shows maximum wetting power.

5. A process of increasing the wetting properties of organic fibrous materials prior to subjecting the said materials to a treatment in an aqueous bath, comprising modifying the swelling rate of the wall of the fibers by repeatedly alternately drying the material at a temperature not exceeding 60° C. and humidifying the material by means of water vapor at a temperature not exceeding 60° C., until the material shows maximum wetting power.

6. A process of increasing the wetting properties of organic fibrous materials prior to subjecting said materials to a treatment in an aqueous bath comprising modifying the swelling rate of the fibers by repeatedly alternately drying the materials and humidifying the materials at temperatures not exceeding 60° C. until the material shows increased wettabiliy and allowing the materials to absorb a substance in gaseous condition which increases the wetting properties of the fibers.

7. A process according to claim 6 in which the substance increasing the wetting properties is used in the form of an aqueous solution.

MEINDERT DANJUS ROZENBROEK.