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## Waterproof and Water-resistant Fabrics

Since prehistoric times man has tried to protect himself against the rain. Thousands of years ago certain small tribes had found the secret of making fabrics water-resistant by impregnating them with vegetable juices. In Europe, the first mention of such a process is found in the 14th century when linseed oil was used for impregnating sailors' oilskins. The wax emulsions in general use to-day, were already partly known in the 19th century. Washable impregnations are a recent invention.

### GENERAL REMARKS.

Formerly, waterproof clothing was used principally by soldiers and certain workmen or craftsmen. But to-day everyone wishes to be independent of the rain. We except our protective clothing to fulfil the following requirements:

1. They must protect us from water, and consequently from the chilling effects of evaporation.
2. They must remain presentable even when wet, that is to say they must not lose their colour or shape in the rain. Various methods of making fabrics impervious to water are known to-day. English, fortunately, unlike French and German, is well provided with a standardized terminology in this field; and it is very useful for the consumer to be able to tell immediately from the designation of an article what properties it possesses. Fabrics impervious to water may be classified in the following manner:

I. **Waterproof fabrics**, impervious to water and air. The waterproofing effect is not generally lost when washed.

II. **Water-resistant, water-repellent fabrics**, impervious to water, pervious to air, and subdivided into two categories:

- a) normal non-washable impregnation;
- b) washable impregnation.

### FABRICS.

The nature of the fibre and the method of weaving have a great influence on the resistance of fabrics to water. Certain qualities are therefore required from fabrics which are to be made waterproof or water-resistant. The way in which the fabrics are made up is also important. Fabrics that are taut or subject to friction absorb water more rapidly than loose fabrics.

These considerations are less important for the fabrics in category I.

### PROCESSES.

I. **Waterproof fabrics**. — Fabrics are waterproofed by covering them with a protective coating. This method is used for tarpaulins, blinds, tents, table-cloths, protective sheets for beds as well as all kinds of protective clothing. These coated fabrics are absolutely impervious to water and are generally resistant to washing and chemical cleaning. They are also very resistant to mechanical wear and tear. On the other hand, these fabrics are also impervious to the air and do not allow body evaporation to escape.

The waterproof coating also modifies the structure, the feel and the colour of the fabric; the characteristics of the coating prevail and the fabric becomes heavier and more bulky. The resistance to tearing at the seams and buttonholes is less effective. When protection is required, capable of resisting rain for hours at a time in spite of mechanical strains (creasing, friction), then a waterproof fabric must be adopted.

II. **Water-resistant fabrics**. — a) Normal impregnation may be obtained according to different processes. Most frequently used are the aqueous wax emulsions. The surface of the threads and fibres of the fabric is coated with microscopical particles of wax, which produce an admirable water-resistant effect in the fabric. The fabric however, remains completely pervious to air so that it does not interfere in any way with cutaneous respiration.

The fabric preserves its structure, its feel and its colour. This method of impregnation is not expensive and can be carried out on

clothes already made up. On the other hand, the effect is not very lasting and diminishes under the action of mechanical and chemical influences. Washing with soap and particularly chemical cleaning completely destroy the water-resistant qualities, and that is why cleaning establishments generally proceed automatically to a new impregnation of the clothes that have been cleaned. In Switzerland, normal impregnation is both the most popular and the most practical of these methods. It is particularly suited to women's raincoats, but it is also quite adequate for sports clothes and men's rain coats, as long as no exceptional qualities are required; the impregnation has to be renewed from time to time.

b) Washable impregnation has only recently been perfected. In this method, use is made of water-resistant substances which are chemically combined with the textile fibres in the course of a relatively complicated industrial process and cannot therefore be easily separated from them. Certain products give an excellent resistance to household washing, that is to say that four or five washes in warm soapy water hardly diminish the effect at all. It should nevertheless be pointed out here that waterproof clothing manufacturers only guarantee resistance to washing if this is carried out according to their instructions. The resistance to chemical cleaning is generally less effective, but it is infinitely greater than that of the products considered in group II a). Naturally the fabric remains pervious to air and keeps its structure, its feel and its colour. Water beads less easily on the fabric with this process than with normal impregnation, but the effect is nevertheless appreciable. It is not possible to impregnate in this manner, clothing that has already been made up. As the method of manufacture and the products used are costly, this method of impregnation is comparatively expensive. This disadvantage is compensated for however by the fact that the effect lasts longer and the operation does not have to be repeated.

Both of the processes described under a) and b) are used to render the following articles water-resistant: raincoats, sports clothes, uniforms, shirts, children's clothing, bathing costumes, stockings, etc.

It must also be mentioned that one of the very great advantages of waterproof and water-resistant fabrics is the fact that they are not easily dirtied. As they do not absorb moisture, ink for example, cannot stain them; mud will not penetrate either and when it remains, can easily be brushed off.

### TESTS.

Various methods exist for testing the quality of an impregnation, in particular the column of water test. Spraying tests (artificial rain) are also effective; the severity of these tests may be varied by altering the quantity and the height of fall of the water. If, however, extensive comparative tests are to be carried out, it is essential to determine the capacity of the fabrics to absorb water. Various universal apparatuses exist enabling all these tests to be carried out in a single operation. EMPA (Federal Laboratory for the Testing of Materials), at St. Gall, possesses one. The test is standardized according to the SVMT\* regulations 25 D 1331. The resistance to household washing and chemical cleaning can also be determined. There is no compulsory standard laid down for these two tests as yet, but regulations A 2521 SVMT 25 are generally adopted; ethylene trichlorine is used for chemical cleaning.

The few remarks above indicate clearly the importance of very careful weaving and finishing of fabrics intended for rain and sports wear. It must also be noted here that Swiss finishing establishments are well-known for their extremely careful work and are therefore capable of carrying out the waterproofing and the making of fabrics water-resistant, in such a way as to meet the requirements of the most difficult customer. This constitutes, generally speaking, the best of guarantees for Swiss waterproof and water-resistant fabrics and clothing.

\* Swiss Association for the Testing of Technical Materials.