THE HORIO LABORATORY

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This laboratory was separated from Kita laboratory in 1938. The chief items of researches are pulp, viscose rayons and the related subjects. Some researches[1] are rather fundamental and others are practical applications on well grounded theories.

Studies on Pulp[2-11]

The material for pulp such as spruce and fir had already been running short two decades ago. In view of the importance of finding some alternative in this country we have been confined to the study of manufacturing pulp with those resinous soft wood as red pine, larch and cedar or such hardwoods as beech and birch.

Now the pulp industry in this country has been developing mostly on the sulphite process, which is specially adapted to the cooking of spruce and fir but is not so favorable for the above mentioned resinous soft woods or hardwood.

We have accordingly tried to apply the sulphate process to the cooking of those latter woods, and fortunately succeeded in obtaining pulp of superior quality with good yields from almost any kind of wood already mentioned. Up to the present we are still continuing these studies chiefly on the cooking by sulphate process as well as on the method of bleaching and purification of the sulphate pulp. Among these investigations the most important and interesting one is that on the manufacture of rayon pulp by sulphate cooking. It has been elucidated that by choosing proper conditions in cooking and bleaching the sulphate process could produce, from almost any woods, an analytically high grade and white pulp, but that such pulp as obtained is usually not usable for the manufacture of rayon owing to the lack of reactivity, and hence to its poor solubility. And these lead to our narrow study on the betterment of reactivity and solubility of the sulphate pulp since 1939, until a new method was contrived which was patented in 1943 and consisted in subjecting wood chips to pre-cooking with water or by steaming for certain hours. The principle of this process was to utilize the acidic matter originally contained in the chip in dissolving out from it the hemicellulose as pentosans that was inimical to the manufacture of viscose.

The alpha cellulose content of the pulp obtained by this method amounted to 95-96% and the yield of the pulp was also fairly good.

A new pilot plant of manufacturing pulp by this new method on a semi commercial scale (1 batch 100 Kg wood chips) has been started since December 1950 in this laborotory by the financial support of Japan Association of Pulp Industry and Japan Synthetic Textile Association. We are steadily obtaining expected results. Some rayon pulp manufacturers are planning to adopt this method erecting mills anew.

Studies on Rayon Yarns and Staples

1) On the Improvement of Strength of Staple Fibers[2]

Staple fibers of former days had pronounced defects, especially in wet strength.

It had long been a big drawback of rayons until at last Prof. Horio and his co-workers succeeded in 1941 in improving greatly (by about 50%) the wet strength of rayon staples by means of "the stretch-fixing method" using 2 coagurating baths. The principle of the method is to improve the configuration of the skin layer by fixing the stretch of the spun thread (tow) by the second hot bath; the process was so simple but effective that soon it spread among many mills and indeed almost all the rayon mills are adopting this method today.

2) On the Manufacture of Crimpted Rayon Staples

The crimped rayon staple of superior quality has long been waited for its appearance not only from the public desire for some good substitute for wool but also from the general need for an effective blend.

As a most natural course of the study a new method of manufacturing crimped staple was developed out of "the stretch-fixing" method mentioned above.[13] This method consisted in leading the tow, which had been drawn through the 1st coagurating bath of low acid and high salts, into the second hot bath at about 85-90°C. This method of crimping is now universally adopted in the rayon staple mills all over the country.

3) The "Low Caustic" Viscose Method[14]

This is the method originally started in this laboratory during the World War II in order to make a successful viscose rayon with the least possible use of NaOH and the accompanying chemicals, made imperative by the then conditions in this country, the lack of alkali. The first feature of this method is to squeeze the alkali cellulose, the pulp sheet after alkali dipping, into 2.3-2.8 times of the original weight of pulp in air-condition against the common practice of 3 times of the same.

Numerous researches had to be carried out before it was practically possible; and indeed in some factories this method was actually adopted during the war. Most of the rayon mills today are adopting a method which is more or less "low caustic" than otherwise - - more "low press ratio".

4) Studies on the Method of Manufacturing Viscose by a Continuous System

The continuous system of manufacturing viscose had long been aimed at, and we had also started investigations in this line, commencing from manufacturing alkali cellulose by continuous squeezing by means of roller press.

As the synthetic fibers from various plastics began to prevail after some years of the armistice of the late world war in this country on one hand, and with the coming to hand of the "Smyth Report" on the circumstances of the fiber industry in Germany on the other hand, the investigation into the viscose system seemed to have been carried out anew from various standpoints. And in this laboratory it has been concentrated upon the continous system of manufacturing viscose, and especially to the study of continuous squeezing of alkali cellulose by a screw press[15] using alkali cellulose in a sludgy state or slurry.

We have so far completed experimentally that the continuous pressing and ageing can be shifted to tests on an industrial scale.

5) On the Improvement of the Properties of Cellulosic Fibers

The improvement of the properties of fibers by means of aftertreatments with plastics has long been known. However, it has almost been limited in this country to the treatment on viscose rayon fabrics mostly with urea-formaldehyde resin.

The present method of improving the properties of fibers has been being studied since 1948 based on the theory concerning the structure of the fibers. An interesing results was obtained first with rayon yarns when treated after the researcher's own method.[16] Unlike those usually obtained by common urea-formaldehyde resin, the rayon yarn thus obtained had pronouncedly different characteristics in possessing a higher wet strength with a higher elongation in the knotted state. It was postulated that the conspicuous feature of the plastic treatment consisted in the composition of the treating liquor, including both the thermosetting and the thermoplastic plastics in proper ratio, and the way of application into the fiber interstices. It is expected that this treatment brings about a radical improvement in the configuration of the viscose fibers and makes the fibers more resilient; for the configuration of the processed fiber is made to be more loose in the outer layer of the fiber, and more compact in the core, contributing to the properties of the fiber so as to be pliable in the outer layer and more rigid in the core: whereas in the viscose rayons as spun today the relation is always quite the reverse in this respect, and this is chiefly responsible for all the pronounced defects of the viscose fibers.

This method was further appropriated[17] to improving those high tenacity viscose rayons which have naturally more compact skin layer, exhibiting the more defects when the fibers are exposed to high tension under higher twists: and as this tendency is inevitable, so far as the present methods of spinning viscose rayons are concerned, the new method of changing the configuration of the high tenacity viscose rayon yarns and staples must be of such a great technical importance.

The method of this plastic aftertreatment was already tested on the fabrics, rayon yarns and staples with great success.[18] The fabrics thus processed showed an exceedingly high crease recovery; and the yarns were quite resilient and exhibited a high pile recovery when made into moquette;[19] and the crimped staple thus processed afforded a good yarn and a most excellent fabrics of high crease recovery with a good hand.

The process is now being studied on a larger scale on the parts of the specialists concerned.

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