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COMMUNICATIONS FROM RESEARCH GROUPS: INVESTIGATION ON THE PARAMETERS INVOLVED IN THE YIELD AND CELLULOSE QUALITY IN THE CALCIUM BISULPHITE PROCESS

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Although the process of purification of cellulose from wood has been well known for many years, there are still some stages that need investigation, particularly where the objectives are improving the economics and the yield of the principal operations.

The raw material, wood, is a natural product from which the natural polymer has to be extracted; but every change in the wood affects the purification process and every old idea must be rechecked.

Applied research thus has to move in two directions: one, using principally statistical methods and mathematical models, to reach quick and immediately utilisable results; the other, closer to basic work, should supply a better knowledge of the phenomena involved to suggest further adjustments of the industrial process.

A key stage in pulping is the delignification (cooking) and one of the most important problems is to decide when it is necessary to stop the reaction to obtain the desired results (delignification extent and DP of cellulose).

The degree of cooking can be controlled by measuring the optical density (OD) of the cooking liquor, which is responsible for dissolving some of the wood components. The best correlation between the degree of delignification of the pulp (expressed by K number) and OD is found at 280 nm and that between cellulose DP (measured as Cuam viscosity) and OD at 490 nm.

These wavelengths were found by a statistical analysis of the results of 100 industrial cookings using a total of six wavelengths (210, 280, 370, 465, 490, 580 nm) chosen by differential spectrophotometric study of different cooking liquors. The six wavelengths found agree well with the overlapping structure of the cooking liquor

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spectra proposed by Norrström & Teader (1971) and Norrström (1972). These findings permit an improvement of 20-50% in the range of output characteristics of the pulp.

In another study unconnected with the above problem, a pink compound that strongly absorbs at 490 nm was isolated, by gel-permeation, from hardwood cooking liquors. This pink-product, which has not yet been identified, may be directly or indirectly connected with the hydrolysis phenomena that are involved in the depolymerisation of the cellulose.

Another important stage in the pulping is the treatment with sodium hydroxide; in this stage it is necessary to maximise the degree of purification of the cellulose fibres (expressed as α content) while minimising the loss of cellulosic material.

Different concentrations of caustic (2-10% on pulp) and different temperatures (60-95°C) of purification were investigated with a pilot plant. It was found that the best selectivity (i.e. ratio between purification degree or α content and yield) can be obtained with high temperatures and low caustic concentrations.

During this work it was also observed that the ratio between xylose and mannose, found in the pulp after the caustic treatment, is constant until a concentration of caustic on pulp of about 3% (0·3% in the liquid phase) is achieved; at higher caustic concentrations the ratio increases rapidly (see Fig. 1).

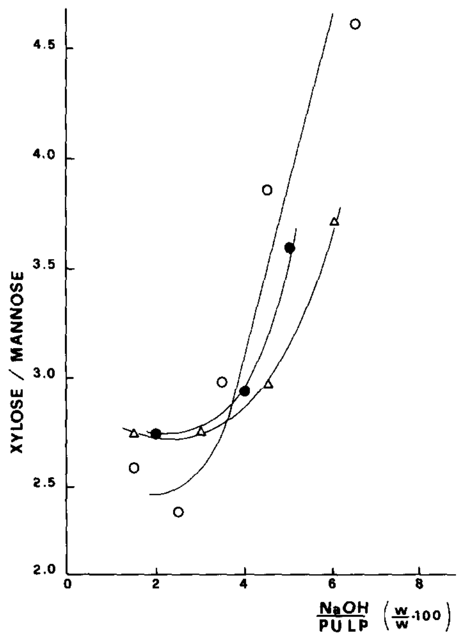

Fig. 1. Xylose/mannose molar ratio in the pulp after treatment with alkali, as a function of the weight ratio (%) of caustic to pulp.

This may mean that different hemicelluloses (for example, glucomannans) become accessible on treatment with more than 3% (on the pulp) of caustic.

Some action on the structure of cellulose fibres with such a low concentration of caustic seems to be confirmed by the work of the University of Genoa Group who, while studying samples prepared in the Torviscosa Pilot plant by the infrared absorbance ratio at 1429/893 and 1373/2900 (cm^{-1}), found a decrease in the degree of crystallinity between samples treated with 1·5% and 6% (on pulp) of caustic, respectively.

Further confirmation of this trend was obtained by differential thermal analysis which demonstrated the presence of more levoglucosan (which develops only in the amorphous area) in the samples treated with 6% sodium hydroxide.

REFERENCES

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