Laboratory Project at Asian Institute of Technology Proves Valuable in Developing Specialty Chemical Applications for Asian Pulp Mills

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ABSTRACT

The application of specialty chemicals in a pulp mill system for the purpose of problem solving or process enhancement is often demonstrated and supported by data produced in laboratory testing. Hercules Chemical Solutions Pte Ltd., a major specialty chemical supplier to the Asian pulp and paper industry, partnered with the Asian Institute of Technology (AIT) on several occasions to provide insight into the efficacy of proposed chemical treatments designed for local operating conditions and wood species. This paper presents an example of a chemically-assisted deresination project. The resulting surfactant chemistry proved to be a superior deresinator for plantation grown acacia wood and has been successfully implemented in an Asian pulp and paper mill.

INTRODUCTION

Hercules is a leading specialty chemical supplier to the pulp and paper industry, holding 19% market share of pulp business around the globe. In Asia, its market share in pulp is 14%. The pulp industry deals with specialty chemicals that are mainly designed for problem solving or process enhancement. Laboratory data specific to a particular mill's own wood and process parameters become a strong tool to support a potential application and to assist the pulp mill in implementing a given chemical program.

Hercules partnered with the Pulp and Paper Technology (PPT) Department of the Asian Institute of Technology (AIT) in Thailand. The Finnish government supports the PPT by providing funds as well as faculty to the department. Thus, it has excellent laboratory facilities and an exceedingly strong faculty.

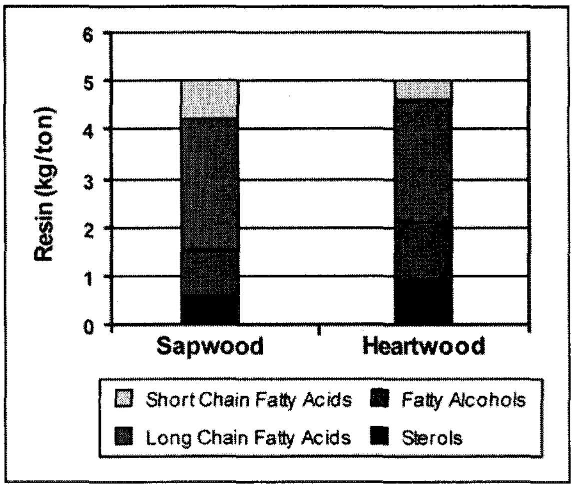

Figure 1 - Resin in Acacia Wood (hydrolyzed).

THE TECHNICAL ISSUE

Acacia pulp is gaining prominence in the Asian pulp and paper industry because of the acacia tree's rapid growth rate and the benefits it brings to sheet uniformity and printability. However it poses a severe problem due to the high extractive content in the wood, which is relatively difficult to remove from the pulp because of the long chain length and very high molecular weight of the resins (see Figure 1).

Producing final pulp containing less than 0.3% DiChloroMethane (DCM) solvent extractive content is the elusive goal of the pulp manufacturer in Asia when using acacia wood chips as the raw material. To meet this challenge, Hercules and AIT partnered to evaluate the deresination efficiency of selected blends of surfactants manufactured by Hercules. Tests were conducted at the AIT laboratory.

EXPERIMENTAL

For this laboratory project, a particular mill's own wood and process conditions were used to support a deresination application. The following describes the experimental procedure used by AIT for this project, which ultimately assisted the mill in implementing the program.

Wood Chips

Acacia wood chips were procured from an Indonesian pulp and paper mill and sent to AIT. Chips were cooked in a CRS Reactor Engineering digester. This digester is a hot air heated autoclave with six individual canisters. Typical process conditions of the mill were maintained. During cooking, surfactant blends A, B, and C were dosed individually at 0.1% and 0.2%, respectively, on the pulp produced along with white liquor.

Cooking Conditions

Table 1 shows the cooking conditions used during laboratory testing.

Table 1 - Cooking Conditions

Condition	Value
Effective Alkali	21%
Sulfidity	30%
Liquor/Wood	3.5
NaOH Concentration	139.1 g/l
Na_2S Concentration	84.1 g/l

Heating Procedure

The acacia wood chips were cooked by heating them at increasing temperatures, from room temperature to 80° C over a period of 10 minutes and from 80° C to 160° C over a period of 75 minutes. Cooking was then continued at 160° C for another 160 minutes.

Pulp Handling

The pulp was washed, screened, centrifuge fluffed, and then stored in a cold storage room at 4°C.

EXPERIMENTAL RESULTS

Table 2 shows the properties of the laboratory produced pulp. Figure 2 shows the average percent DCM solvent extractive content after cooking.

Table 2 - AIT Laboratory Cooking Results

Surfactant Blend	Dosage (%)	Yield	Kappa Number	Residual Alkali (g/l)	Shive Content (g)	DCM (%)
A	0.1	51.7	13.7	10.4	0.02	0.281
A	0.1	51.8	14.0	10.5	0.02	0.29
A	0.2	51.3	13.7	10.5	0.02	0.272
A	0.2	51.0	13.9	9.8	0.02	0.265
B	0.1	51.5	14.1	10.6	0.02	0.31
B	0.1	51.0	13.6	10.0	0.01	0.294
B	0.2	51.3	13.9	10.7	0.02	0.291
B	0.2	51.0	13.9	10.6	0.02	0.302
C	0.1	50.3	13.4	10.3	0.02	0.253
C	0.1	51.6	13.5	9.9	0.02	0.247
C	0.2	51.3	13.0	9.8	0.02	0.231
C	0.2	51.2	13.2	9.8	0.01	0.226
Blank	-	51.3	13.9	10.5	0.03	0.361
Blank	-	51.4	13.7	10.6	0.02	0.35

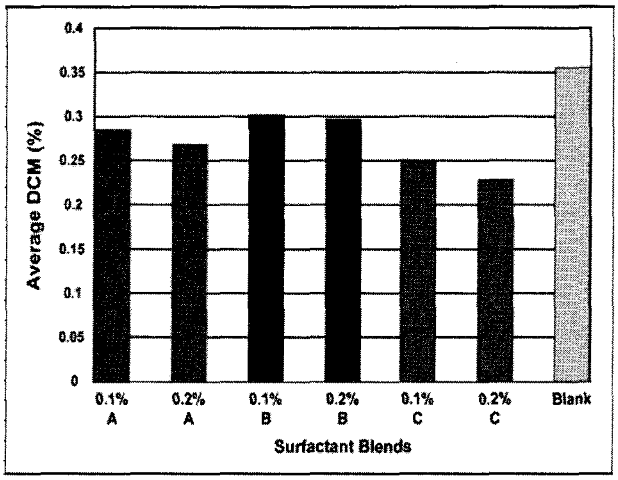

Figure 2 - Acacia Pulp DCM % After Lab Cooks with A, B, and C Surfactant Blends.

MILL EVALUATION

An Indonesian pulp and paper mill using acacia wood chips wanted to achieve a DCM content level of less than 0.3% in the final bleached sheet. Based on the laboratory project conducted at AIT, surfactant blend C was selected for the mill evaluation. The surfactant was dosed along with cooking liquor to the super batch digester system.

MILL EVALUATION RESULTS

Pulp samples from across the pulp mill's fiber line were analyzed for DCM extractive content (see Figure 3).

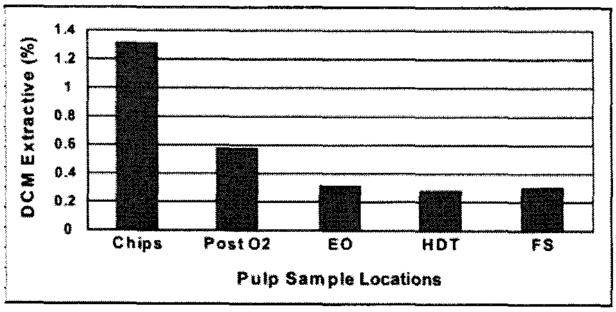

Figure 3 - Extractive as Percent DCM Obtained at Different Locations Across Pulp Mill.

To understand the deresination effect of the selected surfactant, the chips' dust and the residual extractive in the final sheet were analyzed by Gas Chromatography and Gas Chromatography Mass Spectrometry (GCMS). The results, shown in Table 3, confirm that longer chain fatty acids and fatty alcohols are difficult to remove. Only about 55% to 65% were removed.

Table 3 - Gas Chromatography and Gas Chromatography Mass Spectrometry Analysis Results

Extractive	Acacia Wood Chips (μg/g)	Final Sheet (μg/g)
C16:0	102	12
C18:2-9,12	139	n.d.
C22:0	109	54
C24:0	819	390
C26:0	2,342	1,187
C28:0	2,856	1,458
Sum of Fatty Acids	6,367	3,101
Sum of Fatty Alcohols (C24-C28-OH)	3,023	1,156
Sum of Omega Hydroxy Acid (OH22-28C22-28:0)	4,057	1,542
Sum of Sterols	634	n.d.

Next, the pulp mill's final pulp sheet samples treated with and without surfactant blend C were analyzed for DCM content. This confirmed that with surfactant blend C the mill could maintain the DCM content of less than 0.3% (see Figure 4).

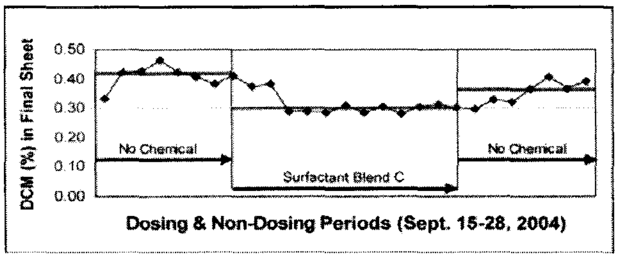

Figure 4 - Extractive Trend of DCM in the Final Sheet with Hercules Surfactant Blend C and without Chemical Dosing (September 2004).

CONCLUSION

Hercules and AIT evaluated the deresination efficiency of several surfactant blends. Based on the results, an Indonesian pulp and paper mill using acacia wood chips evaluated Hercules surfactant blend C. Using this surfactant, the mill achieved its targeted DCM extractive content level, which confirmed the results obtained at the AIT laboratory. As in the AIT project, the longer chain fatty acids and fatty alcohols proved most difficult to deresinate.

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