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Non-process element mass balance improves recaust and lime kiln efficiency at Elk Falls mill

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Abstract: Filtered lime mud at the Elk Falls mill had low solids content and was dark green. Along with high NPE dead load, this caused additional kiln fuel costs of nearly $300,000/year. An NPE mass balance was obtained, using composite samples from fifteen different process streams. Kiln fuel oil was a significant source of phosphorus, iron and zinc. NPE specifications for lime rock, fuel oil, salt cake, and clarified green liquor were established. Cost-effective process modifications increased lime mud solids content and reduced kiln dead load.

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This paper describes a non-process element (NPE) mass balance conducted at Elk Falls mill. This study was implemented to provide a clear picture of NPE accumulation in the Elk Falls lime cycle. NPE accumulation was suspected of causing low solids content in filtered lime mud and excessive kiln dead load. Incremental fuel costs from these two factors were estimated at nearly $300,000/year. The mass balance was necessary to determine the most cost-effective way to address the process problems, and to provide the data needed to establish NPE specifications for lime rock, fuel oil, salt cake and clarified green liquor.

The mass balance mill trial was designed based on a detailed understanding of the chemistry of the Elk Falls green liquor clarifier and lime cycle as reported by Taylor and McGuffie [1].

Located near Campbell River on the east coast of Vancouver Island, Elk Falls began operation in 1952 as a single-line newsprint mill. The paper machine was joined with a kraft pulp mill on the same site in 1956, and two other paper machines followed in 1957 and 1982. A kraft paper machine was installed in 1966. Sawdust pulp, a product pioneered at Elk Falls, was first manufactured in 1964 and capacity was expanded in 1983. The kraft mill was simplified in 2004, and is now a single-line operation. Elk Falls currently produces about 830 t/d of kraft and 1600 t/d of TMP.

The behaviour of NPEs in the kraft recovery cycle has been reviewed [2,3]. A number of papers have been published on the mill concentrations of NPEs in kraft process streams [4-10]. The effect of NPEs on kraft mill efficiency was recently reviewed [11].

This paper examines a wider range of NPEs than previous mill studies and includes additional process streams important to the lime cycle, including weak wash, kiln fuel oil and dregs filtrate. Process changes made at the Elk Falls mill as a result of the mass balance are also discussed. Based on this work, NPE specifications for lime rock, fuel oil and clarified green liquor were established for the Elk Falls mill.

METHODS AND MATERIALS

For each of the 15 process streams examined, three samples were collected over an eight hour period on August 25, 2005 and combined into one composite sample. Raw green liquor was a two-sample composite because of a change that occurred in recovery boiler operation. Lime rock was a composite sample collected May 19, 2005. Pulp production on August 25, 2005 was 565 ADT. Results are given in Tables I and II.

Samples for the mill trial were collected in polyethylene sample containers. Containers were first soaked in 1+1 HCl, then rinsed in deionized water and dried before sampling, to eliminate possible metal contamination.

Elemental concentrations were measured by Econotech Services Ltd., Delta, BC. Samples were digested with aqua regia at 100°C for 2 hours. Some samples required alkali fusion with sodium carbonate and boric acid at 1000°C. After digestion, samples were analyzed by inductively coupled plasma (ICP) spectroscopy. Total element content was measured in liquid samples.

Flow rates of process streams were initially estimated using process instrumentation, and then adjusted to balance sodium ion mass flow. Flow adjustments were made for white liquor (+10%), strong black liquor (–25%) and weak wash to dissolving tank (+33%). No other flow adjustments were made, and good balance of the sodium mass flow was obtained, as seen in Tables III and IV.

RESULTS

1. Overview of Samples Collected for Mass Balance

Elemental concentrations of the collected samples are shown in Table I for samples that were solid or measured on a solids basis. Elemental concentrations in Table II are for liquid samples. There are several initial observations that can be made about the results in these two tables.

Weak and strong black liquor solids have the same sodium and potassium concentrations as expected, but NPE levels vary considerably between the two. Silicon, magnesium and calcium showed the largest differences. This shows that there is significant variability in the black liquor composition, probably due to changes in the wood used. This could be due to variability in NPE concentration in the wood itself, or to

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