Magnesium hydroxide; an alternative alkali source in hydrogen peroxide bleaching of wood pulp

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ABSTRACT

After many lab trials and large scale trials, a reduction of chemical oxygen demand (COD) and higher amounts of residual hydrogen peroxide could be proved, if magnesium hydroxide had been used as alkali source in hydrogen peroxide bleaching of wood pulp. Additionally it could be proved, that the necessary amount of magnesium hydroxide and the bleaching results at a given amount of hydrogen peroxide were dependent from the purity and the fineness of the magnesium hydroxide. The magnesium hydroxide dissolves continuously during the bleaching process by consumption of alkali. Thus, the initial pH-value at the beginning of the bleaching process is lower compared with a caustic soda / silicate system. It amounts to 8. This fact probably causes the reduction of the chemical oxygen demand (COD) and influences the kinetics of the bleaching reaction in two ways:

The rate of the undesired hydrogen peroxide decomposition into water and oxygen at a high concentration of perhydroxyl anions and thus at a high pH-value [1], is probably reduced and the amount of residual hydrogen peroxide increases. The higher amount of residual hydroperoxide effects, that nearly no brightness loss can be observed during unplanned shut downs.

The speed of the bleaching reaction is lower, so that the best bleaching results are obtained after a bleaching time of 3-3,5 hours and the minimum bleaching time amounts to 2 hours, if magnesium hydroxide is used as the only alkali source.

INTRODUCTION

During the past 19 years, it was reported several times about experiments with magnesium oxide (precursor of magnesium hydroxide) as an alkali source in hydrogen peroxide bleaching of wood pulp [2, 3, 4]. In these papers the complete replacement [2] and the partial replacement [3, 4] of caustic soda and sodiumsilicate by magnesium oxide or -hydroxide was suggested. Associated to that, it was mentioned, that the fineness of the magnesium component and the optimal mixing in the wood pulp was very important.

Furthermore it was found, that the chemical oxygen demand (COD), caused by hydrogen peroxide bleaching, could be reduced, when magnesium oxide had been used. Compared with conventional bleaching formulations using caustic soda and silicate the reduction amounted to 30 – 40% [4]. This point is important in respect of clean process water circuits and fiber loss.

The reduction or the complete replacement of sodium silicate by magnesium hydroxide can help to avoid silicate precipitation, which can cause damages and affect runnability. The dewatering properties of the wood pulp can be improved and the anionic trash can be reduced, if a lower amount of silicate or no silicate is necessary [5].

Based on the described results of the papers mentioned above and based on the thesis of Mr. Stefan Kürzeder [6], graduate engineer (paper industry), our company (Kürzeder & März) could gain experience in this field as a manufacturer of stabilized magnesium hydroxide suspensions (trade name: Kaliol) over the last 15 years.
The product is used as a complete substitute for silicate and as a partial or complete substitute for caustic soda at several paper mills for bleaching SGW, PGW and TMP. Results about that were presented at the Andritz Bleachers Forum in 1999 by MD Plattling paper mill, Germany [7].

RESULTS AND CONCLUSIONS

During a large scale trial in a paper mill, where normally caustic soda is used as the only alkali source in hydrogen peroxide bleaching of spruce wood pulp, the COD-load in the water after the disc filter could be reduced significantly by using magnesium hydroxide instead of caustic soda. Figure 1 shows the amount of reduction during high bleaching (5% hydrogen peroxide commodity):

![Figure 1: Reduction of COD-load (kg/bdmt) in the water after the disc filter during high bleaching (5% hydrogen peroxide commodity) with magnesium hydroxide (Mg(OH)₂) instead of caustic soda (NaOH).](image)

As it can be seen from figure 1, the COD load could be reduced by nearly 19 kg/bdmt in case of high bleaching at an equal or higher brightness level by using magnesium hydroxide instead of caustic soda.

As the initial pH-value in case of magnesium hydroxide, which represents a buffered alkali system, is much lower compared with caustic soda (it amounts to 8 instead of 10-11), less organic substances are extracted from the wood pulp. The buffering effect is caused by the continuous dissolving of magnesium hydroxide, when alkali is consumed during the bleaching process. The bleaching time amounted to nearly 4 hours.

The use of magnesium hydroxide in the hydrogen peroxide bleaching generates more residual hydrogen peroxide. According to our experience, residual peroxide values of caustic soda/silicate systems typically are 10-40% corresponding to the originally added hydrogen peroxide. In case of a magnesium hydroxide system this value amounts to 20-60%, if comparable bleaching results are obtained. The reason for the higher amounts of residual hydrogen peroxide in case of magnesium hydroxide is once again the lower pH-value in the pulp. As a consequence, the rate of the undesired decomposition of hydrogen peroxide into water and oxygen, which is typical at a high pH-value and thus at a high concentration of perhydroxyl anions, decreases [1]. As long as the higher level of residual hydroperoxide does not affect a following dithionite bleaching step, which can be avoided by a washing step, it
represents an advantage, because the incoming brightness can be increased by the higher hydrogen peroxide content in the back water. Furthermore the brightness of the bleached wood pulp can be kept stable during unplanned shut downs.

Figure 2 shows the brightness values and the residual peroxide values of a bleached spruce wood pulp vs. storage time over 20 hours at bleaching temperature (70°C) after using magnesium hydroxide as alkali source in hydrogen peroxide bleaching:

![Graph showing brightness and residual peroxide values over storage time](image)

Figure 2: Brightness values and residual hydrogen peroxide values over further 20 hours storage time at a temperature of 70°C after bleaching with 3% hydrogen peroxide (commodity); incoming brightness: 57.82.

The data in figure 2 demonstrate the high stability of the gained brightness after using magnesium hydroxide.

The brightness loss after bleaching is less than 1 point after keeping the pulp on bleaching temperature for 20 hours. The high amount of residual hydrogen peroxide makes that possible. It decreases from about 50% to about 35% corresponding to the originally added hydrogen peroxide amount.

The gained brightness and the necessary amount of magnesium hydroxide at a given amount of hydrogen peroxide are dependent from the purity and the fineness of the magnesium hydroxide suspension.

Magnesium hydroxide suspensions with a lower particle size are more active, as the magnesium hydroxide dissolves more quickly. Nevertheless the lower pH-value reduces the velocity of the bleaching reaction compared with caustic soda and silicate. Figure 3 should demonstrate that:
Figure 3 illustrates the lower velocity of the bleaching reaction by a slower increase of brightness in case of using magnesium hydroxide as alkali source. Nevertheless, after using magnesium hydroxide the final degree of brightness is equal to the one gained with caustic soda and silicate after 3 hours of bleaching time.

Finally some aspects in the field of practical use should be mentioned:

A magnesium hydroxide suspension does not represent a hazardous material in contrast to caustic soda. For keeping the suspension homogeneous, a storage tank with a small agitator is necessary. The dosage equipment needs not to be adapted.

References