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Definitions of terms in the sulfite pulping process

Scope

This Technical Information Paper includes a glossary of standard terminology used in the sulfite industry. It covers terms used for the production of alpha cellulose pulps at one end of the yield range and high-yield semichemical pulps at the other. Diverse pulp properties are obtained by treatment with various cooking liquors over the full range of pH from acid to alkaline and with different bases.

Safety precautions

Not applicable for terminology document.

Definitions

Acid (as it pertains to acid sulfite and bisulfite pulping processes):

1. *Raw acid*: the cooking liquor as made in the acid plant before fortification.
2. *Storage acid*: acid in reserve for transfer to acid accumulators or directly to the digester in the bisulfite pulping process.
3. *Accumulator acid*: storage acid held in pressure vessels during fortification by SO₂ from digester relief gas or by the addition of liquid SO₂.
4. *Cooking acid*: the fortified acid for direct use in the digester.

Base: the cation which combines with the sulfurous acid. Bases in common use today are:

1. *Calcium*: this usually is obtained in the form of limestone, which is reacted in a tower with SO₂ and water to form calcium bisulfite [Ca(HSO₃)₂]. Since both the bisulfite and monosulfite have low solubility, an excess of sulfurous acid is maintained, and the pH of the liquor is in the range of 1 to 2.
2. *Magnesium*: this base is usually purchased in the form of a slurry containing 50-60% dry Mg(OH)₂. It combines with SO₂ to give magnesium bisulfite [Mg(HSO₃)₂], which is sufficiently soluble that a cooking liquor with a pH up to 6.0 may be used, but pH's do not normally exceed 5.0.
3. *Ammonia*: ammonia is normally purchased in the liquid, anhydrous form which easily mixes with water to form ammonium hydroxide (NH₄OH), which is 18-25% NH₃. The monosulfite [(NH₄)₂SO₃] or bisulfite (NH₄HSO₃) formed with SO₂ are both readily soluble over the entire pH range. However, the practical upper pH limit is about 9.
4. *Sodium*: this cation is normally obtained as a concentrated solution of NaOH (caustic soda) or as dry Na₂CO₃ (soda ash). These react with SO₂ to form sodium monosulfite (Na₂SO₃) or sodium bisulfite (NaHSO₃), both of which are readily soluble in water. Sodium base systems can be used over the entire pH range.
5. *Potassium*: similar in physical and chemical properties to sodium, but more expensive. Not commercially used at present, but has been suggested for small capacity mills to pulp non-wood fibers such as wheat straw. The waste liquor, properly treated, may be used as a crop fertilizer, and no complex, expensive chemical recovery system would be needed.

Buffering agent: chemical added to liquor to regulate the pH. Examples: soda ash (Na_2CO_3) or aqueous ammonia (NH_3).

Buffering ratio: ratio of buffering equivalents to sulfite equivalents.

Cooking liquor: liquor as it is charged to the digester and as it exists in the digester at the start of cooking.

Cooking process (batch digester processes):

1. *Cooking time:* measured from start of steaming to start of the blow.
2. *Time to temperature:* measured from start of steaming until the digester's temperature has been raised to the maximum temperature.
3. *Time at temperature:* total elapsed time after the digester has reached maximum temperature until start of blow down.
4. *Blowing time:* from opening the blow valve until digester is empty.
5. *Cooking cycle:* from start of one cook to start of next cook in the same digester; often expressed as "cover to cover" time.
6. *Top relief:* gas and entrained liquor vented from the top of the digester during the cooking operation to maintain a set pressure.
7. *Side relief:* cooking liquor withdrawn from the digester in the early stages of the cook and returned to an accumulator or storage vessel. This is done to provide gas space at the top of the digester, to permit top relief with a minimum of entrainment, to allow easier pressure control, and to recover some heat and chemicals.
8. *Blow down* (or 'gas down' or 'pressure-blowdown' or 'draw down' or 'drag down'): relief of gas and steam to lower the digester pressure from the maximum to the blow pressure and to recover the SO_2 at the end of a cook.
9. *Blow:* opening the blow valve to empty the digester after the pulp is cooked and digester pressure has been reduced to a predetermined level. Alternatively, the contents can be removed by relieving the pressure from the top to the accumulator, followed by flooding with weak waste liquor, and pumping the slurry to a tank. This minimizes the loss of SO_2 as well as air pollution, and the pumping action simulates the defibrating action of blowing under pressure.
10. *Blow pressure:* digester pressure at which the blow valve is opened to empty the digester.

Digester charge: the chips and cooking liquor in a digester.

1. *Wood charge:* oven-dry weight of wood per digester.
2. *Bulk density* (packing factor): oven-dry weight of wood per unit of digester volume. (A comment on the danger of using "packing factor," etc.: there is generally a lack of a clear definition of meaning by users of term, because chips can be packed to a higher density than normal by various mechanical or fluid [steam] measures.)
3. *Liquor-to-wood ratio:* ratio of the weight of the cooking liquor charged to the weight of the over-dry wood charged. The liquor weight may or may not included the weight of the water in the chips; it should be clearly specified which formula is being used.
4. *Chemical-to-wood ratio:* ratio of dry weight of chemicals charged to the weight of over-dry wood charged express as:
 - (a) Total SO_2 on wood, %
 - (b) Combined SO_2 on wood, %
 - (c) Free SO_2 on wood, %
 - (d) In neutral sulfite semichemical pulping (NSSC), sodium sulfite plus buffer, each expressed as Na_2O ; for ammonia, the sulfite plus buffer as NH_3 , expressed as a percentage on oven-dry wood. For completeness, the buffering ratio must also be stated.

Direct steaming or cooking: method of cooking whereby the cooking temperature is attained by introducing steam directly into the digester.