Mixing efficiency of the new IntensaPulper compared with a conventional pulper. These test results under identical conditions (stock consistency and power consumption) show mixing progress 5, 10 and 15 seconds after color injection.

The IntensaPulper – a revolutionary energy-saving pulping concept

It has always been a matter of course for Voith to take Total Cost of Ownership into account in new machinery design and developments. In times of sharply rising energy costs, energy-saving machinery is even more important, and applies particularly to stock preparation machinery.

This article examines the various operating modes of pulpers defibering primary fibers. A new development is introduced that uses only as much energy as actually required for pulping. For example, significant energy savings can be attained with this pulper concept, which features a design that has remained almost unchanged for decades.

Influence of operating mode on energy consumption

Primary furnish can be pulped either in individual batches or in continuous operating mode. Most pulpers for defibering primary fibers today are operated in batch mode.

The new IntensaPulper with eccentrically arranged rotor and double cone bottom for optimal mixing and flow configuration.

The batch-pulping mode is usually preferred for throughputs below 200 t/24h, or for complex mixtures of different kinds of primary fibers associated with frequent changes of product and/or color.

Batch pulping involves unproductive work cycles, such as filling and emptying of the pulper vat. A considerable amount of energy and time is consumed that would otherwise be available for the actual pulping process. The production capacity of batch pulpers is therefore lower than that of continuous pulpers. Another drawback of batch pulpers is stock consistency fluctuations, due to dilution during the intermediate emptying and flushing phases.

Continuous pulping is clearly more energy-efficient. This operating mode is suitable for throughputs exceeding 200 t/24h, and it uses a relatively straightforward furnish mix. Continuous pulping consumes about 40% less energy compared with the batch-operating mode. Moreover, with a suitable control strategy, the stock consistency remains constant and simplifies the overall stock preparation process.

Agitation and mixing

Optimal agitation is indispensable during every pulping phase, and only as much energy should be applied to the suspension as is actually required for the defibering process. This means, that in a batch-pulping mode, the surface motion of the suspension can almost cease when the stock consistency is high at the end of each pulping phase. On the other hand, there must be enough agitation in a continuous pulper to draw the bales into the rotor vortex – on no account can they be allowed to settle at the bottom of the pulper. The optimal agitation energy can be defined by the coefficient of power to volume [kW/m^3], which varies according to application and operating mode.

Another important criterion for optimal pulping is the flow pattern on the surface of the suspension. This is much more difficult to evaluate, because it cannot be defined in terms

of a simple coefficient. Good mixing of the suspension requires frequent rotor contact with the furnish bales, and in practice this is assessed visually. If, for example, a bale remains on a concentric circulation path for too long in the pulper, it does not contact the rotor frequently enough. As a result, mixing is inadequate and so is pulping. To ensure intensive mixing, most pulpers today have baffles on the vat wall to break up the flow pattern by diverting the mainly rotational flow inward toward the rotor. The drawback is that flow interference entails loss of energy. This applies not only to the baffles, but also to the pulper bottom design. Voith has been carrying out development work on both these components in order to make optimal use of flow energy for pulping.

Energy-optimized agitation through asymmetrical motion and optimal pulper bottom design

As a result of these developments, the new IntensaPulper incorporates two important features:

- The rotor is positioned eccentrically in the cylindrical vat.
- The transition from the pulper bottom to the vat walls is flow-optimized with a double-cone design.

An eccentric rotor arrangement in the pulper vat results in good mixing, thanks to asymmetrical flow. The IntensaPulper rotor is therefore installed off-center. Since this alone optimizes mixing, no energy-wasting baffles are required and more energy is available for pulping.

An optimized transition from the horizontal pulper bottom to the vertical vat walls enables further exploitation of flow energy for pulping. In the new IntensaPulper, the transition from the pulper bottom to the vat walls is optimized with a specially designed double-cone bottom. The two cone angles are precisely determined to simulate a low-loss, torospherical profile optimally diverting the flow generated by the pulper rotor.

Potential savings with the IntensaPulper

Performance tests on a 20 m^3 IntensaPulper, operating in batch mode, showed a 26% reduction of specific energy consumption [in kWh/t] compared with the conventional pulper previously used. Furthermore, production output was 7% higher, with the same defibering quality.

In absolute figures, this means that an IntensaPulper with an output of 100 t/24 h saves about 175,000 kWh per year. This energy savings reduces operating costs significantly.

In continuous operating mode, specific energy savings with the newly developed IntensaPulper are similar. Particularly for large throughput capacities, the resultant cost savings can be substantial.

Summary

- A pulper defibering primary fiber in continuous operating mode principally consumes about 40% less energy than in batch mode because unproductive energy-consuming phases are avoided.
- The IntensaPulper has an eccentrically arranged rotor for optimal mixing – without energy-wasting baffles on the pulper walls.
- The IntensaPulper bottom is flow-optimized with a double-cone design.
- Results: the eccentric rotor arrangement of the IntensaPulper saves about 25% specific energy in batch pulping mode and increases production throughput while achieving the same defibering quality.

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