

Internal Pumping in Stock Tanks: Energy-Saving Agitators

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Agitators are devices used to pump paper stock inside tanks. Because in an average paper mill high amounts of stock are pumped, also a lot of pumping energy is needed. Sulzer Pumps Finland Oy produces agitators and other devices with high efficiency and therefore low energy consumption.

1 *Agitators like the Salomix agitator by Sulzer Pumps are used for internal pumping in tanks to keep the stock homogenous. (The photo shows the motors of the agitators outside the tanks.)*

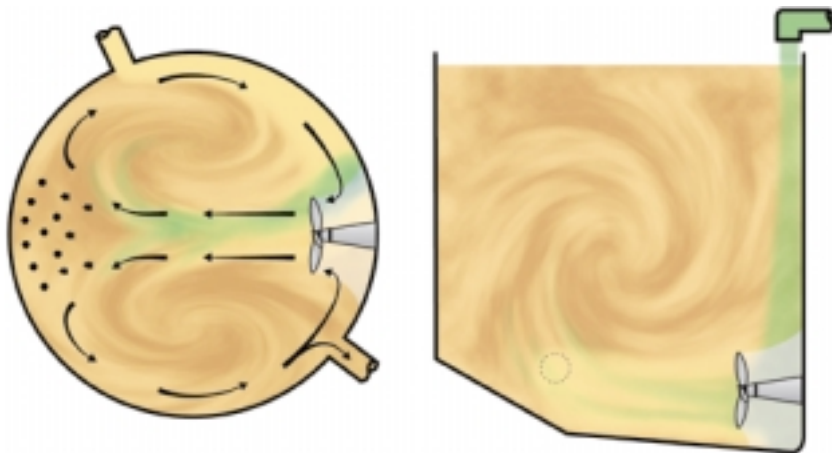
■ Paper stock normally contains more than 95% of water. This means that a mill which produces 100 000 t per year must handle about two million cubic meters of stock. All this stock is pumped from the beginning of the process to its end through several tanks. And the filtrate water, about 95% of the stock, will also be pumped back.

For all this, a considerable amount of pumping energy is needed, both

for transfer pumping and for internal pumping in tanks to keep the stock homogenous for the process. This internal pumping is carried out with agitators (Fig. 1[■]). The size of the tanks is normally calculated on the basis of the stock flow from the tank in order to achieve a certain retention time. Inside the tank, there is a combination of many internal flows: The main flow is created by the agitator, which is selected so that a certain

volume of stock is in motion. If the purpose of agitation is only to prevent sedimentation, e.g. to keep the bottom zone in motion, the power needed is smaller than if the total volume is agitated. Higher consistency stock needs more energy. Very often, agitators are selected for a consistency higher than the real operational consistency. However, 4% stock can be agitated with only 60% of the energy that 5% stock requires.





2[■] The discharge nozzle is far enough from the low-pressure zone behind the propeller, and the inlets are on the opposite side of the agitator to the discharge. Inlets flow smoothly with the main flow.

INFLUENCE OF PIPEWORK

Besides the agitator there is always also an inlet flow and a discharge opening in the tank. If the discharge nozzle is located too close to the propeller, the pump must draw the stock from the suction side of the propeller. Sometimes the pump is stronger and sometimes the agitator, and a lot of energy is wasted. If the inlet flow can make a shortcut to the discharge side, it is pumped out directly instead of becoming mixed. For example, dilution water often escapes this way. To avoid all this, the pump nozzle must be located far enough from the propeller (Fig. 2[■]).

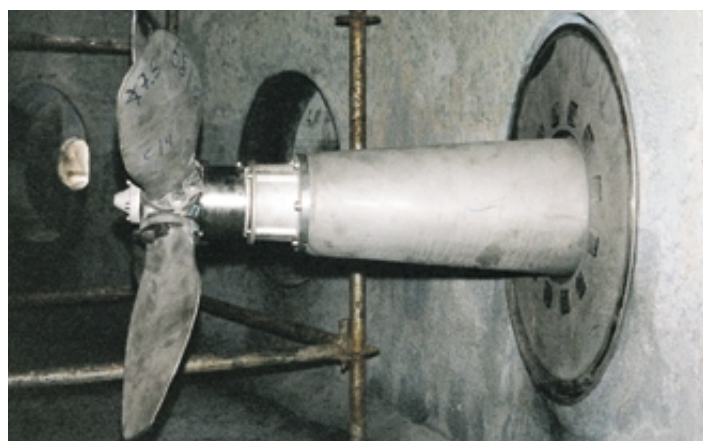
The low-pressure zone between the propeller and the tank wall may cause an internal flow. If a propeller shaft is too short, the agitator loses much of its pumping capacity due to the internal flow of the propeller (Fig. 3[■]). Sulzer Pumps' SalomixTM agitator has a long shaft, so the propeller can work with high efficiency.

Tank bottom fillets play an important role for internal flows. They may be sloped such that the vertical flow is strengthened, increasing agitation in the upper part of the tank. In some cases, vertical flow is not desired. On one side,

diluted stock flows upwards, and on the other side, the stock flows downward, causing variations in the discharge consistency. A fillet called Plough developed by Sulzer Pumps divides the agitation into two horizontal flows, keeping the strong agitation force only in the bottom zone of the tower. In addition, with a dilution cone called Dilco, dilution water can be fed into the center of the propeller, where the turbulence is at its highest and mixing at its best. Dilco reduces the energy consumption and, sometimes, even a smaller agitator can be selected.

UPPER PART OF A TOWER

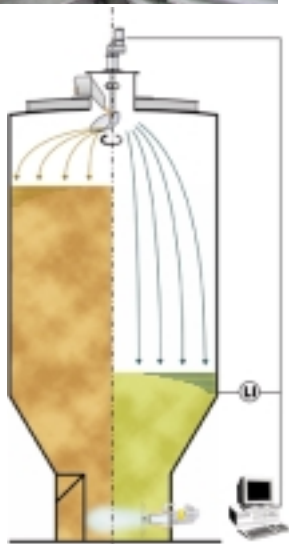
In a paper stock tower, there is a border zone between the low-density and the high-density zones. The agitator has no role in the high-density zone; the internal flow there is created by gravity and the kinetic energy of the inflowing stock. In most towers, some sort of channeling is created through the border zone into the bottom zone. This channeling may cause loss of brightness in bleached stock. When the stock level decreases, the darker stock comes out of the tower. Sulzer Pumps has developed a Top-Entry Spreader (TES;



3[■] Three agitators with too short shafts have lost propeller blades (top). A single modern SalomixTM agitator (bottom) was mounted into this 1200-m³ tank in February 1997, and does since then the job of the three agitators.



4[■] The Top-Entry Spreader is a rotating unit which is mounted on the roof of the tower. The variable rotating speed is computer-controlled, so an even layer of fresh stock is spread into the tower at any stock level.



5[■] The Vulca method fills the tower so that inflow does not mix air into the stock. The pumping energy can be adjusted, so that, with a low level, the speed of the pump is lower than with a high level.

Fig. 4[■]) to reduce channeling in this zone.

Some bleaching towers are operated at even 30% consistency, and the stock is diluted to low consistency in the bottom zone of the tower. These towers need a lot of dilution water and very strong agitation. To control the consistency, it is important that the internal flow in the tower is correct. Sulzer Pumps has patented a fillet which enables extremely high agitation for dilution without disturbing the high-density stock downflow. This fillet forms a level interface between the low-density zone and the high-density zone where the interface gradually expands upwards. The volume of the agitated zone is so small that the retention time in the dilution zone is only some minutes. A small agitated volume needs less energy than a larger volume.

UNDER LEVEL CHARGING

Some large storage towers are normally operated at a rather low level, so first a pump lifts the stock all the way up and then it is allowed to fall down again ten or even thirty meters, depending on the height of the tower and the operational stock level. When the stock finally hits the surface, the splashes of stock mix a lot of air into the storage zone. Later on in the system, this air must be removed. All this creates a lot of energy waste. Sulzer Pumps has developed a charging method where it is not necessary to pump stock high up. In this Vertical Under-Level

Charging Arrangement (Vulca; Fig. 5[■]), stock flows upward like magma through a volcano. The tower can be filled in the same way as a volcano grows layer by layer, with no air being mixed into the stock. Pumping energy can be adjusted according to the stock level in the tower.

A Finnish pulp mill installed the Vulca system in 1997 to a blow tank after batch digesters. After this modification, annual energy savings exceeding 85 000 EUR could be reached. Before Vulca, their washing plant suffered from a high air content in stock. Now the air content has been reduced roughly by 50%, giving much better runnability at the washing plant. They have also noticed that the discharge time of the digesters is now shorter. Vulca can be used in storage towers for filtrate water, broke or low-density stock.

Sulzer Pumps carries out studies of internal flows in the tank which may lead to considerable energy savings and also improved process operation, so the studies are paid back in a short time. This concerns both old and new tanks. Ω

FOR MORE DETAILS

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