

Paper Stock Pumping

Paper Stock has characteristics that make it more difficult to handle than water. These are:

- Fiber length
- Freeness (tendency to dewater)
- Degree of agitation
- Entrained air
- Consistency of the stock

Broke Service

Broke service pumps in the standby mode must operate at relatively low flow with a throttle discharge. At the time of the break, the pump must rapidly remove the broke to a broke storage area for reprocessing. These wide flow swings create heavy mechanical loads that must be taken into account when selecting the pump.

Some mills use a two-pump system, with the smaller pump (called the trim pump) handles the low flow and the low head recirculation requirements of the hydropulper. The second pump (broke transfer) comes on-line when there is a break in the sheet. This pump transfers the broke at high flow rates and high heads to the broke storage area.

Centrifugal Cleaner Service

Due to the nature of the cleaner process, the pumps installed in the various stages are subjected to abrasive operating conditions. The stock consistency is 0.5% or higher.

Pumps feeding the primary and secondary bank of cleaners can be either end suction or double suction. Tertiary cleaner pump should always be end suction pumps in 316ss or CD4 materials. The open impellers are well suited to handle the high amount of debris and abrasives present in the tertiary and higher stages. The open impeller provides much longer service life than enclosed impellers.

Shower Service

Some of the paper machine shower services are felt, wire, trim, and knock-off. They require generation of high pressures at flow rates varying from only a few gpm to 700-800 gpm. Generally single or multi-stage pumps are used operating at two pole speeds. Pitot tube pumps are also used for this service. The stuffing box pressures of these pumps are well above 50 psig, so mechanical seals or metallic packings are required.

Coating Applications

Clay slurries, normally around 70% solids, have dilatant shear characteristics. That means the viscosity of these slurries increases with increasing shear rates. If we operated an end suction pump with the standard clearances (0.015 inches between the impeller and casing) the clay would solidify and stall the pump. Typically, extra clearances are provided on both the front and back of the impeller. This is usually achieved by machining off the face of the impeller to increase the clearances of the pump. Due to the increased clearance inside the pump, the impeller and motor have to be oversized to compensate for the pump's loss of efficiency.

Coating slurries, such as titanium dioxide, calcium carbonate, calcium stearate, and cooked starch present their own special sets of pump problems.

- Calcium carbonate & Cooked Starch solutions can be handled like water
- Calcium stearate at 70% exhibits a viscosity of 300 –500 SSU

- Viscosity is higher when the slurry flows through the pipe than when the slurry flows through a pump. Conventional performance corrections for viscosity are used for these services.
- The pump materials are 316SS and Alloy 20 where the coating slurries are treated with sulphuric acid.

Many mills presently use progressive cavity, rotary piston, and gear pumps are used for these services since these pumps exhibit lower shear rates, and require less suction head.

Black Liquor

Recovery and evaporator sections handling black liquor present many difficult pulp mill applications. Weak black liquor (10-20% solids) is easily handled with no requirement for viscous correction. Above 50%, a viscosity correction becomes necessary. Typical viscosities are 100-300 centipoises depending on the temperature of the black liquor. The higher the temperature, the lower the viscosity. When the solids are above 35%, all 316SS or CD4 construction is used.

Bleach Plant Services

These services present a challenge when it comes to corrosion. Various chemical services require pump constructed of 316SS or 317SS stainless steel to titanium. When chlorine dioxide is present the minimum material is 317SS. For chlorine dioxide with large amounts of free chlorine present, or for calcium and sodium hypochlorite applications, titanium is preferred. Hastelloy B & C are not often utilized in bleach plants because 317SS can be used at much lower cost.

Recovery Area Services

Green liquor, white liquor, and lime mud services usually involve abrasive solids that have a dramatic effect on the pump life. Green liquor in particular is abrasive due to the inert materials left after burning. White liquor is also considered abrasive. Clarified white liquor is less abrasive. End suction pumps in minimum 316SS material are required for these services. CD4 is proven to be more suitable for green liquor, white liquor, and lime mud services. If these pumps are oversized, then there will be increased internal recirculation, which causes accelerated wear and higher stuffing box pressures. Concentric casings are less susceptible to this type of wear. Rubber and hypalon lined pump are used for these services.

Digester Recirculation

Digester recirculation pumps are subjected to severe temperature and pressure swings. Thermal expansion of the piping in such applications can cause severe loads to be placed on the pump casing. On batch services the pump must come up to service temperature and pressure and then cool down between batches. Because of the pressures and temperatures encountered, 300 lb pipe flange ratings are normally used. To withstand the extreme pipe loads, pumps with spring-mounted baseplates are often utilized. The spring mounting allows the pipe to move in horizontal and vertical planes without imposing excessive flange loads on the pump. Special packing or mechanical seals are usually required due to the high suction pressures found throughout typical systems. In addition, the use of pressurized stuffing boxes is common due to the need for preventing the abrasive pumpage from entering the stuffing box.

Fan Pump

This is the critical pump for the paper machine, in its achievement of high paper quality. This pump today is driven by variable speed systems, rather than constant speed drives which require throttling valves, and recirculation lines.

With the movement to larger machines and higher speeds it is critical that the suction piping and discharge piping be closely analyzed.

Tangential inlets on the side of suction transition pieces tend to create very poor flow distribution to both sides of the fan pump impeller. Therefore, recirculation and stock entries on the vertical centerline are more desirable. Even more desirable is the dumping of the stock recirculation lines back into the wire pit rather than into the suction piping.

Double suction pumps with impellers having split, staggered, and skewed vanes have long been recognized as the most common pump for fan pump service. Today's current trends are pump with casings and rotating elements of 316SS, especially for fine paper machines. Improved casting methods have reduced pulsations.

It is extremely important that entrained air be eliminated on this service. Entrained air can cause operational problems such as air binding, or inconsistencies in process flow resulting in line formation on the sheet. Entrained air can also retard drainage, and therefore requiring slower machine speeds. Care must be made to submerge the suction line so that vortexing does not occur. Also there should never be any pockets that allow air to collect in the suction line. Furthermore, on pumps that are not top centerline discharge models, so provision should be made for venting air that collects at the top of the casing.

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