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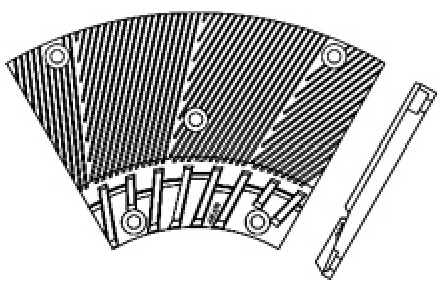
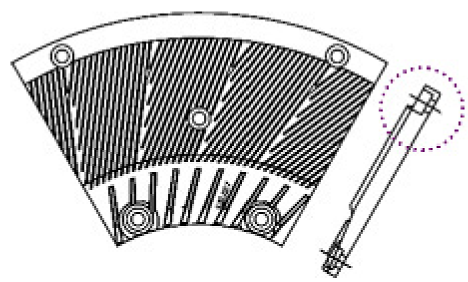
Underhung Plate Designs:
Potential $100k Energy Savings and Improved Refining Conditions

Underhung plate designs incorporate a smaller effective refining surface which offers the potential for significant energy savings. They can also be an effective tool for addressing Low Flow applications.

Standard Segment



Underhung Segment



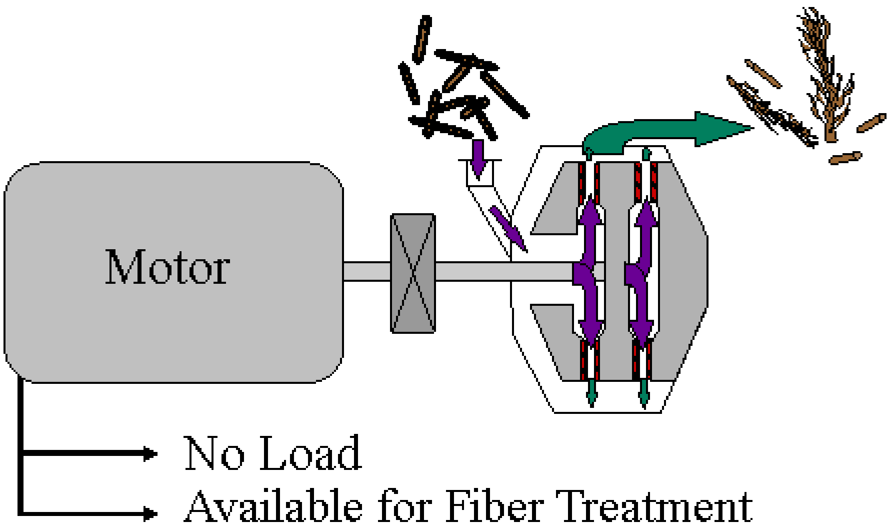
Lower No Load

Reducing refiner No Load levels can provide a mill with significant energy savings. For some, this could equate to $100k annually. The following explanation shows how.

The amount of energy transferred from the refiner's motor to the fiber determines the level of refining "Specific Energy." Each fiber type has a recommended Specific Energy level which should result in optimum fiber development.

Specific energy can be calculated by the following equation,

$$\text{Specific Energy} = \text{HPD/T} = \frac{\text{Motor Load (HP)} - \text{No Load (HP)}}{\text{TPD}}$$



“No Load” or “Waste Load” is the total power required to overcome the “drag” the refiner motor encounters as it spins while processing fibers with the plates backed all of the way out. This No Load “drag” is always present, even when the refiner is operating at normal plate gaps.

No Load consists of both mechanical drag and hydraulic drag. The mechanical drag arises from the inherent inefficiencies associated with spinning the motor and refiner shafts. The hydraulic drag arises from additional inefficiencies brought about by the spinning of the rotor and its refiner plates in a pulp slurry.

No Load can be estimated for any double-disk refiner with the following equation,

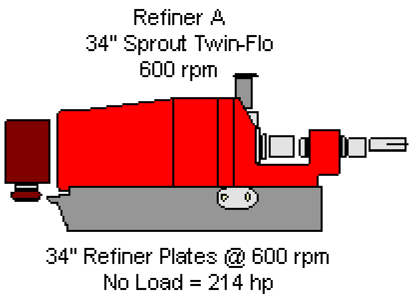
$$\text{No Load (hp)} = 3.083 \times 10^{-13}\, D^{4.249}\, \text{rpm}^3$$

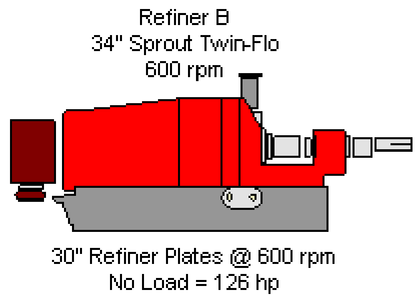
(D is effective plate diameter in inches and RPM is refiner motor speed)

One should allow for a 5-10% margin of error with this equation for a brand-new or fully-rebuilt refiner. The No Load of a poorly maintained refiner can be appreciably higher.

With their smaller effective refining diameters, underhung plates require less No Load power while still allowing for the required level of Specific Energy.

Let’s look at an example: consider two 34” Sprout Twin-Flo refiners, both operating at 600 rpm. Refiner A is equipped with 34” plates, Refiner B 30” plates. Using the No Load equation above, Refiner B’s No Load is 126 horsepower, 88 horsepower less than Refiner A.





If the mill has four 34” Twin-Flo refiners that are candidates for 30-inch underhung plates, the potential energy savings can be considerable. Four refiners with 88 horsepower less in No Load requirements equals 352 total horsepower in energy savings. Assuming 340 operating mill days per year at $0.05 per kWh for electrical energy, the potential energy savings would equate to approximately $100k while maximizing available Specific Energy levels.

Low Flow Application

In addition to energy savings, underhung plates are also effective in improving refining conditions in Low Flow applications.

Assume Refiner A cited above is the softwood refiner for a printing and writing paper machine. Let’s also assume the normal softwood flow this refiner has to process is 480 gpm at 4.0% consistency. Let’s also assume that piping and controls for flow recirculation does not exist.

With standard 34” plates installed the recommended flow range for this refiner is 550 - 1650 gpm. At the normal flow rate of 480 gpm this means the refiner is operating in a Low Flow condition. A Low Flow condition typically leads to a higher propensity for plate clashing and inefficient refining.

Equipping this refiner with a 30” underhung pattern lowers the recommended flow range to 400 - 1100 gpm which better fits the required 480 gpm of softwood tonnage this printing and writing paper machine consumes. Reducing the effective refining surface to 30” puts this refiner in a more favorable hydraulic operating window. This in turn will greatly reduce any propensity the refiner may have for plate clashing and improper refining.

Underhung plate designs are appropriate in certain situations and have the potential to save a mill a significant amount in electrical energy or improve refining efficiency. Contact your J&L Sales Representative to see how underhung plates may benefit you.

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