TECO Complete Cascaded Refiner Control Solution

Introduction

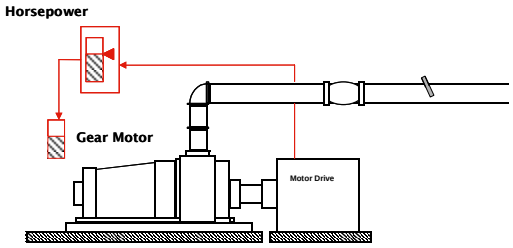
Refiners manipulate paper stock by rotating plates or cones so as to impact the fibers of the pulp slurry. Simply put, these impacts have the effect of cutting and fibrulating the various fibers, which in turn affects the fibers ability to interact with each other (strength) and ability to drain water (freeness). Experience shows that for a given fiber furnish, a particular amount of refining will produce a paper with a desired strength and/or freeness specification. If there is too much or too little refining the finished paper product will not meet these specs and will most likely have to be recycled or discarded. Properly controlling the refiner, then, is critical to the paper making process.

Refiner Control – Motor Load

The most basic form of refiner control is known as Motor Load Control. In this mode, the amount of energy that the refiner uses at any time is monitored and controlled. An energy usage set point (most commonly measured in horsepower) is selected, usually from experience, and the refiner motor is kept at that level of output by adjusting the refiner plate separation. This is the most commonly used form of refiner control in American paper mills. The TECO Brainac™ Level I Refiner Controller product executes this form of refiner control.

Motor load control is effective if the paper furnish consistency and production rate remains constant. If either the consistency or production rate varies, the amount of energy which is delivered by the refiner to any particular volume of stock will also be variable. This will result in changing strength and freeness qualities of the finished paper product.

Level I – Motor Load



To explore this point a little further, if a refiner is set to a particular energy setting, then every gallon of stock which flows through the refiner at the same rate will receive the same amount of energy (assuming each gallon has the same amount of fiber content). If the rate of flow increases, then each gallon of stock will receive less energy. If the flow rate drops, then each gallon of stock will receive more energy. Conversely, if the amount of fiber in each gallon changes, the amount of energy each fiber receives will also change. Thus, a more advanced control environment is called for, one in which volumetric flow rate and fiber content is accommodated for, which leads us to the next mode of refiner control, horse-power-day per ton (HPDT) control.

Horse Power Day per Ton Refiner Control

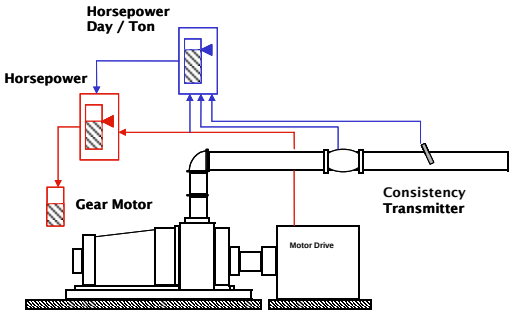
In HPDT refiner control, the controller is cascaded with additional consistency and flow rate measurements. This second stage of control first calculates the amount of fiber that is flowing through the refiner at any particular

moment and calculates a horsepower set point for the first stage motor load controller. In this way, the HPDT scheme adjusts the motor load of the refiner such that each unit of stock flowing through the refiner receives the same amount of energy.

This control scheme is becoming increasingly popular in the United States as mills search for ways to reduce variability and control costs. Managing refiner energy for specific paper products has been shown to produce significant benefits for the papermaker, both in terms of paper quality and production stability.

The HPDT scheme is executed by TECO's Brainac™ Level II refiner controller product. Consistency measurement is possible through TECO's superior StockRite™ line of consistency transmitters and flow rate measurement is achieved using TECO's convenient line of two-wire flow transmitters.

Level II - HPDT

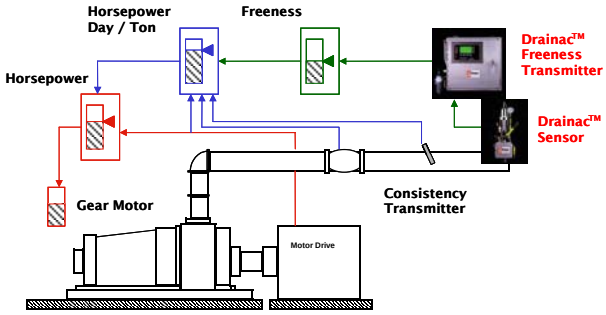


Where HPDT control falls short is when one considers how much refiner energy is needed for a particular furnish to achieve a certain strength specification. Papermakers know that strength doesn't always increase with more and more refining energy. What you typically find is that strength increases as you refine a stock up to a point and additional refining past that point actually *decreases* strength. So the papermaker has to find that refining "sweet spot" and go no further than that. The question then becomes one of how to find that sweet spot. The answer lies in freeness measurement and leads us to the third mode of advanced refiner control, freeness endpoint.

Freeness Endpoint Refiner Control

Strength measurements in pulp stock are somewhat problematic, particularly when considered in terms of refiner energy. It is far more convenient to make a measurement of a paper characteristic that is both consistent with strength and relates well to the amount refiner energy. That characteristic is freeness, or the ability of paper stock to drain water. Given that freeness decreases with additional refiner energy, it is only necessary to determine a range of freeness which correlates with the desired strength produced by the refiner at a particular HPDT setting. Once this freeness is known, the third stage of refiner control can be implemented.

Level III – Freeness Endpoint



Using an online freeness measurement device, the third stage of refiner control takes in the measurement of stock freeness and calculates a HPDT set point for the second stage HPDT controller. This cascaded control strategy then causes the stock to be refined to a particular

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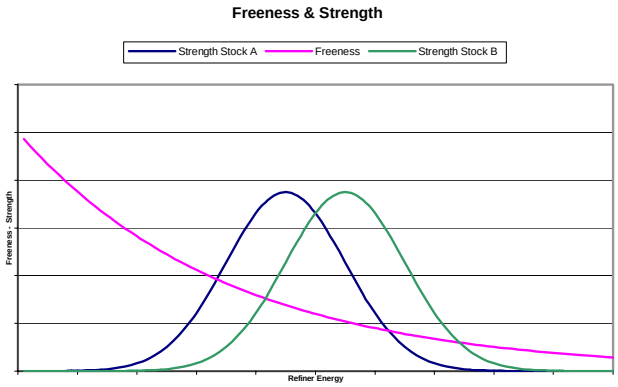
freeness range and no further. The second stage accommodates changes in production flow rate and consistency while the first stage manages refiner energy. The freeness endpoint control scheme is executed by TECO's Brainac™ Level III refiner controller product. Freeness measurements are made using the TECO Drainac™, the worlds fastest, lowest cost and most reliable online freeness analyzer.



Benefits of Triple Cascaded Refiner Control

There are several benefits realized by the papermaker using this triple-cascaded refiner control scheme. First, and most important, the papermaker consistently achieves the strength specification necessary for his product. He eliminates product variability and is able to both maintain his grade and eliminate waste and product rejects. Secondly, by managing his refiner loads to the precise limit necessary to meet his grade specification, the papermaker avoids over-refining his stock. As refiner motors are typically very large, this will translate into huge energy savings.

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The Total TECO Refiner Solution

TECO is the only US manufacturer which brings the complete refiner control solution to the papermaker:

- TECO's Brainac™ refiner controller product brings Level I Motor Load, Level II HPDT and Level III Freeness Endpoint control together into one product. As an added benefit, the Brainac comes standard with advanced, plate-safety control algorithms which prevent plate crashes due to losses of pressure, flow rate or consistency upsets.

- TECO provides superior and cost-effective consistency measurement with the StockRite™ line of consistency transmitters. These advanced instruments are able to measure consistency under the most difficult conditions and can automatically compensate for variations in production flow rate. For a nominal fee, the StockRite™ line can be optionally fitted with advanced dilution control.

- TECO makes flow rate measurement simple with its line of two-wire flow meters. These low cost instruments can be powered directly by the StockRite™ transmitter or any other 4-20 ma power source.

- Superior freeness measurement is made possible using the TECO Drainac™, the world's fastest, lowest-cost and most reliable freeness analyzer.

- Finally, refiner optimization is realized using the advanced PaperNET product. This product provides online indication of the furnish sweet spot for refiner control in real time.

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