OPTIMA
TECHNICAL BULLETIN
Volume VI • Number 1

Low Consistency Refiner System Design Considerations

Developed by the Technical Group, J&L Fiber Services

OVERVIEW

- A flow meter and inlet/outlet pressure gauges are the minimum instrumentation required for proper refiner system operation.
- Consistency control is important for assuring high quality pulp.
- The four basic types of refiner control are manual, power, specific energy, and drainage.
- Each type of refiner control has its advantages and disadvantages, depending upon the design of your refiner system.

There are many different types of refiner system setups being used today. This *Optima* discusses the basics of some of the more common arrangements. This is not a detailed discussion to be used for designing a refiner system; rather, a general discussion outlining some of the techniques and requirements for a well-designed refiner system.

Basic instrumentation and control requirements

Inlet, outlet, and differential pressures are important tools for determining how a refiner is operating. They provide useful information regarding plate wear and operating conditions related to throughput. The differential pressure of a refiner also provides the refiner plate supplier with useful information in determining what type of plate design is most suitable for a given application.

In order for the pressure measurements to be meaningful, a flow measurement must be available. This is also required when running specific energy control (power applied per ton).

A flow meter and inlet and outlet pressure gauges are therefore the minimum instrumentation required for proper operation of any refiner system.

Consistency control is also important for any refiner system, since all refiners are sensitive to consistency swings. Excessively variable consistency will cause inconsistent, and possibly, poor pulp quality.

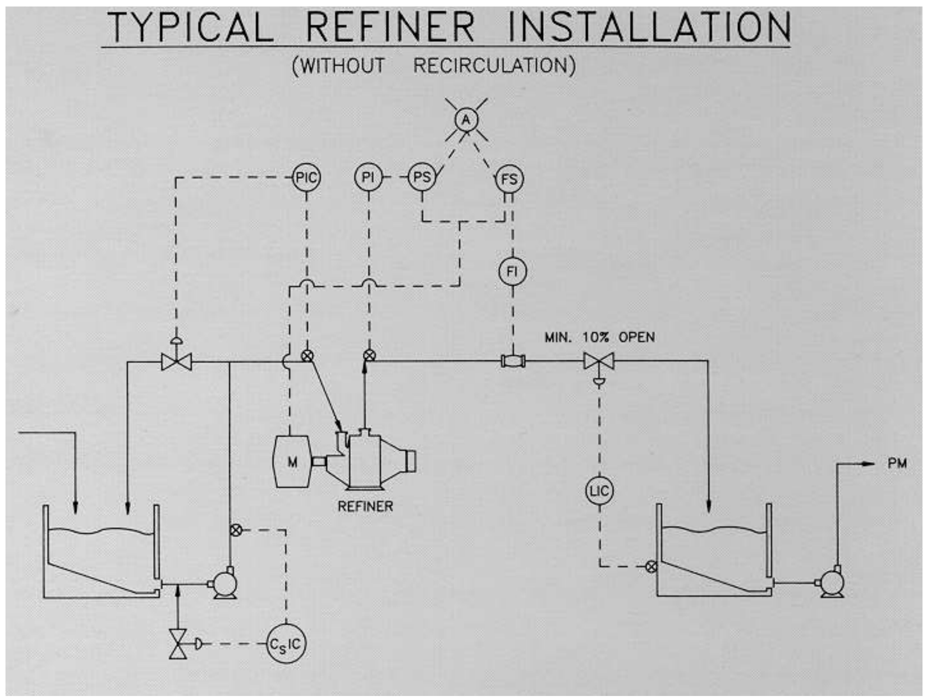
Refiner energy input control is an important topic for consideration. There are four basic types of refiner control currently being used: manual, power, specific energy, and drainage.

Manual control is self explanatory. The operator makes manual adjustments to the power being used based on pulp quality requirements.

Power control uses an automatic controller to maintain a set point power (amp, hp, kW) regardless of process changes. This type of control is actually worse than manual since the control logic will maintain a set power input even if the flow drops off.

J&L FIBER SERVICES

Fig. 1: *Single refiner without recirculation*



Specific energy control (hp-day/ton or kW-hr/ton) maintains the net power input into the fiber based on mass flow. This type of control will correct for system changes in consistency and flow, but will not correct for changes in the incoming fiber characteristics. Specific energy control is usually considered the minimum control requirement for a state-of-the-art refining system.

Freeness (drainage) control is also widely used. In this type of control, a drainage device measures the stock sample after refining and adjusts the specific energy control setpoint. This type of control system does correct for variations in the incoming fiber supply. It should be used in conjunction with a specific energy control because of the relatively long lag times associated with the sampling equipment available.

In the following discussion, certain abbreviations are used:

CsIC = Consistency Indicating Controller

PIC = Pressure Indicating Controller

FIC = Flow Indicating Controller

PS = Pressure Switch

FS = Flow Switch

System designs: single refiner installations

Single refiner without recirculation (Fig. 1). The simplest refiner system is a single refiner without recirculation. This refiner system is used when a single refiner has both sufficient energy and flow capacity to handle the projected production rate/fiber quality requirements. In this system, the flow rates can be variable but are not excessively variable or low enough to require recirculation. Stock is processed through one refiner to the next process step. Refiner energy input in this system can be done either manually, by straight power input via specific energy control (hp-day/ton or kW-hr/ton), or through the use of drainage-type controls. The type of control used is dependent on the degree of variation in the system and the degree of control and variation acceptable in the process.

In general, these systems have inlet pressure control to prevent excessive inlet pressure to the refiner. Typically this inlet pressure is kept between 20-40 psig (138-276 kPa). Lower inlet pressures can result in undesirable trip-outs caused by the inlet low pressure switch.

Higher pressures are not normally required and only cause excessive energy use (oversized pumps) and higher packing water pressure requirements. Also, high refiner discharge pressures usually result in poor flow control due to the excessive pressure drop that must be taken across the flow control valve.

For safety considerations, the control valve should be designed to fail open and should be limited to minimum 10% open to prevent over-pressurization of the refiner. Outlet high pressure and low flow switches are for safety considerations, and indicate that there is no flow being processed by the refiner. This can lead to rapid over pressurization. The switches are interlocked to first unload the refiner and then shut it down if the condition persists for more than a short period of time.

Single refiner with recirculation (Fig. 2). This system is used whenever a single refiner has both the flow and power capacity to process the maximum projected throughput, but is oversized for the minimum throughput demands. Low flow is very detrimental to a good refining operation, and can cause excessive plate wear and poor refined pulp quality.

Recirculation systems are also being used more for refiner system safety considerations. While a properly instrumented and controlled refiner system without recirculation can be run safely, there is an extra safety factor of a recirculation system in preventing a no flow condition from occurring.

In this system, the stock is recirculated from the discharge side of the refiner back to the pump suction. Controls are similar to the system mentioned previously, with the addition of the recirculation controls.

System design: multiple refiner installations

Series refining (Fig. 3). When the power input required is excessive for a single-pass refining application, series refining is used. Series refining systems are exactly like single refiner systems, with the exception that each refiner needs to have individual safety and power input controls.

Fig. 2: Single refiner with recirculation

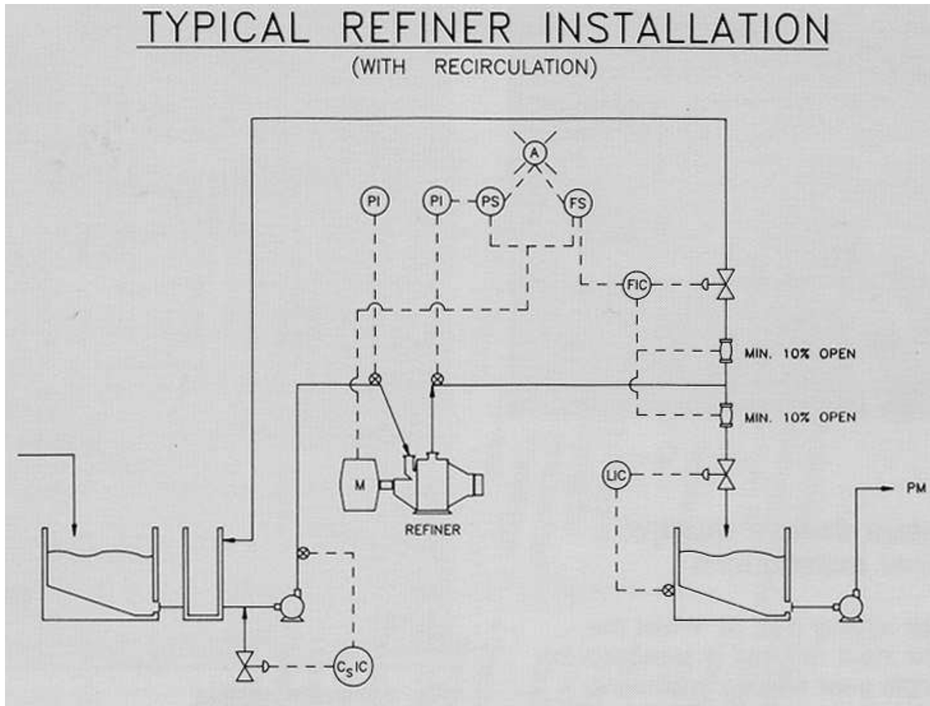
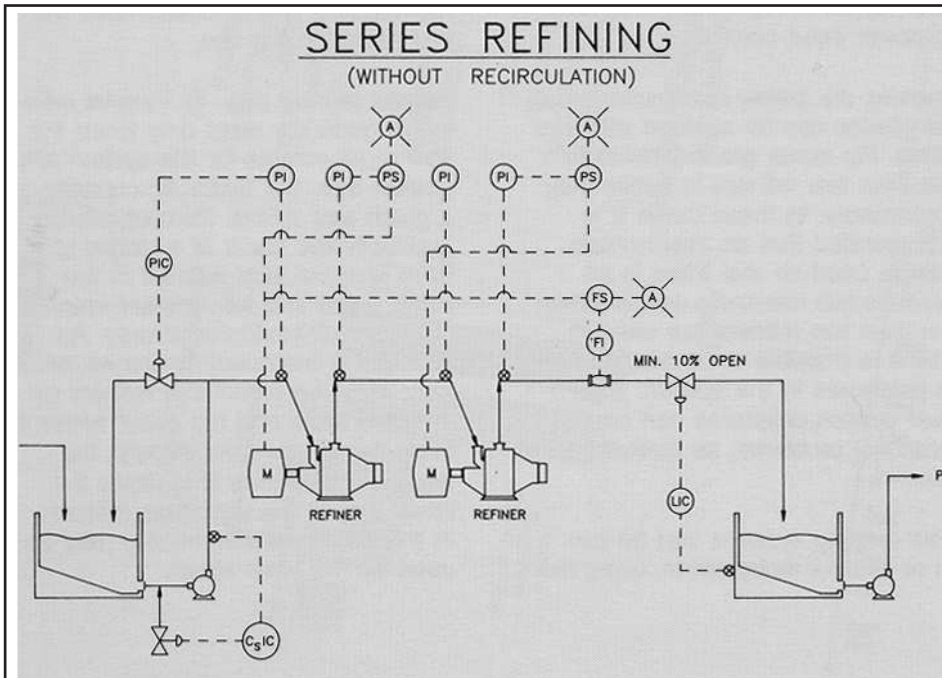


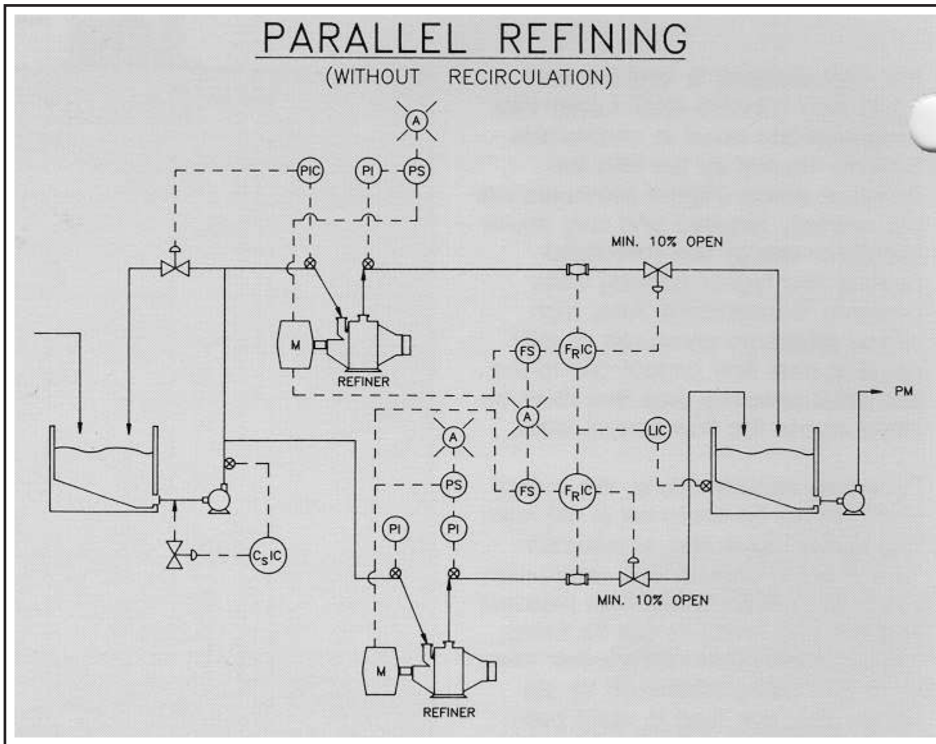
Fig. 3: Series refining



Generally, the power requirements for most grades can be attained with two refiners. For some grades, however, more than two refiners in series may be necessary. In these cases it is recommended that an intermediate chest be used so that there is no more than two refiners in series. When more than two refiners are used in series it is possible to develop excessive pressures in the system. High refiner system pressures can cause operational problems, as discussed earlier.

Series refining systems can be run with or without recirculation, using the same criteria as a single refiner. The recirculation line is located after the last refiner in the line.

Fig. 4: Parallel refining



Parallel refining (Fig. 4). Parallel refining is generally used only when the flow requirements for the system are greater than the hydraulic capacity of a given size refiner. Parallel refining is usually the result of a desire to have identical size refiners in the same paper mill for different machine productions/grades structures. An example is linerboard machines, which may have the same size refiners on both the base and top sheet systems even though the flow through the base sheet refiners is typically 3-4 times that of the top sheet refiners. In this case, parallel refining may be used for the base sheet.

It is important that each line in a parallel system have a flow meter and flow control valve to help provide equal refining in the system. Recirculation can be used with a parallel refining system, and may be necessary depending on the system's flow range requirements.

Parallel refining generally is not desirable because of the difficulties in controlling the system to attain identical results from both lines. Any difference in flow, consistency, power applied, plate design, or plate life can cause one line to have different pulp properties.

J&L FIBER SERVICES
A PRECISION CASTPARTS COMPANY

J&L Fiber Services, Inc. • 809 Philip Drive • Waukesha, WI 53186 USA • Phone 414-544-1890 • Fax 414-547-8166