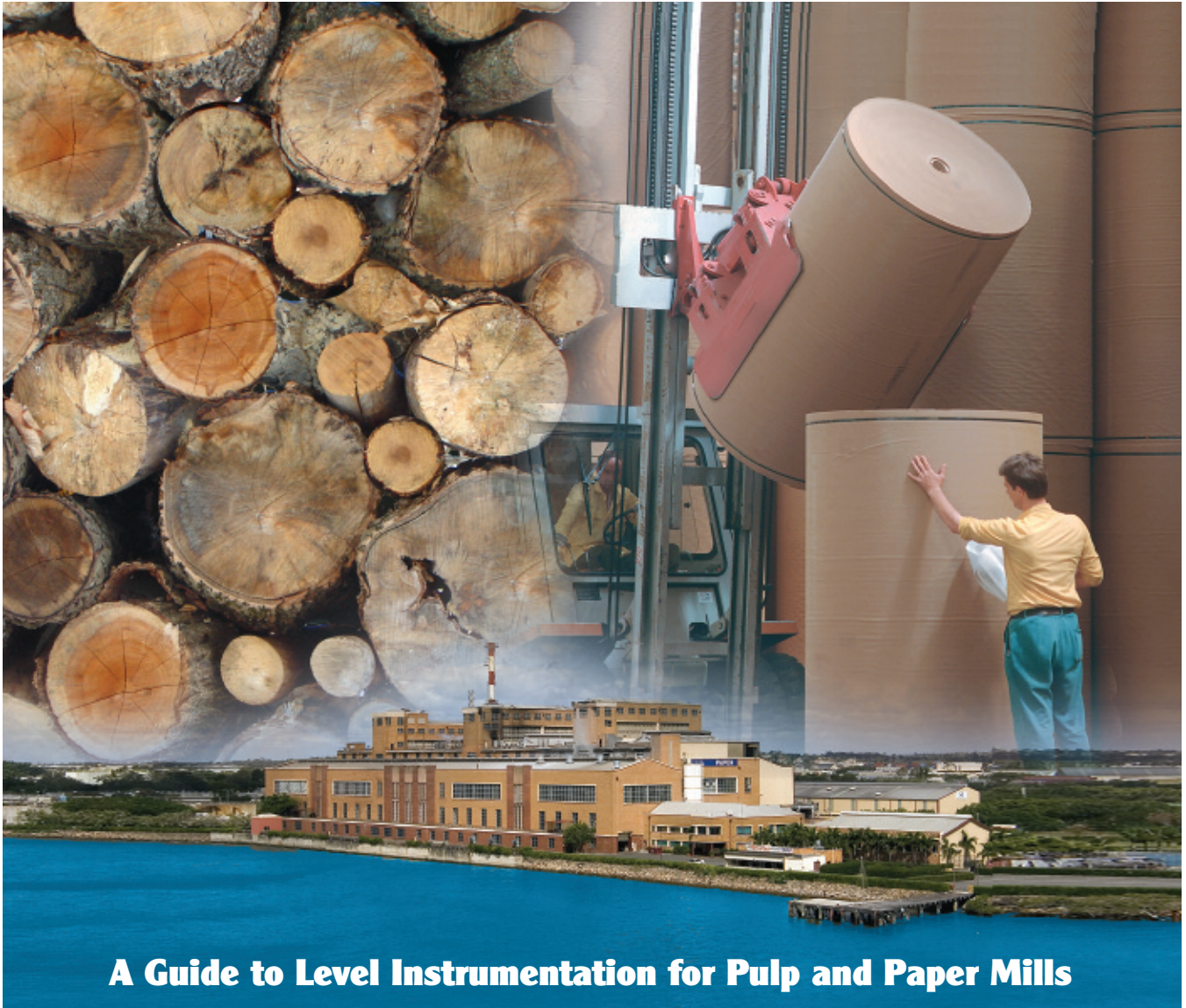




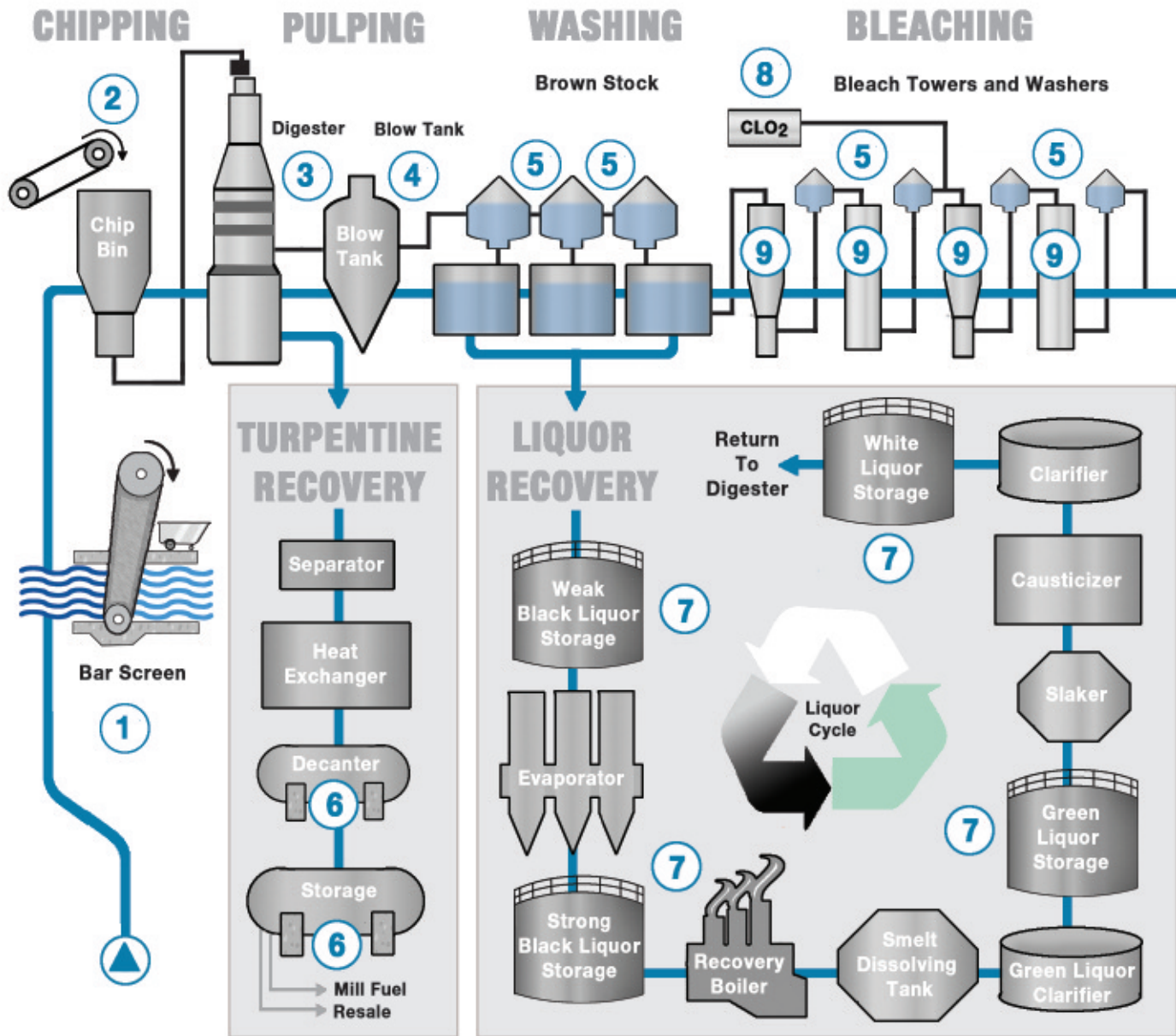
INDUSTRY APPLICATIONS SERIES

PULP & PAPER MILLS



A Guide to Level Instrumentation for Pulp and Paper Mills

PULP & PAPER MILL *A Magnetrol Guide To Level Applications*



LEVEL APPLICATIONS

These applications utilize level instruments for process control. A separate alarm using a different technology often serves as a back-up for spill detection.

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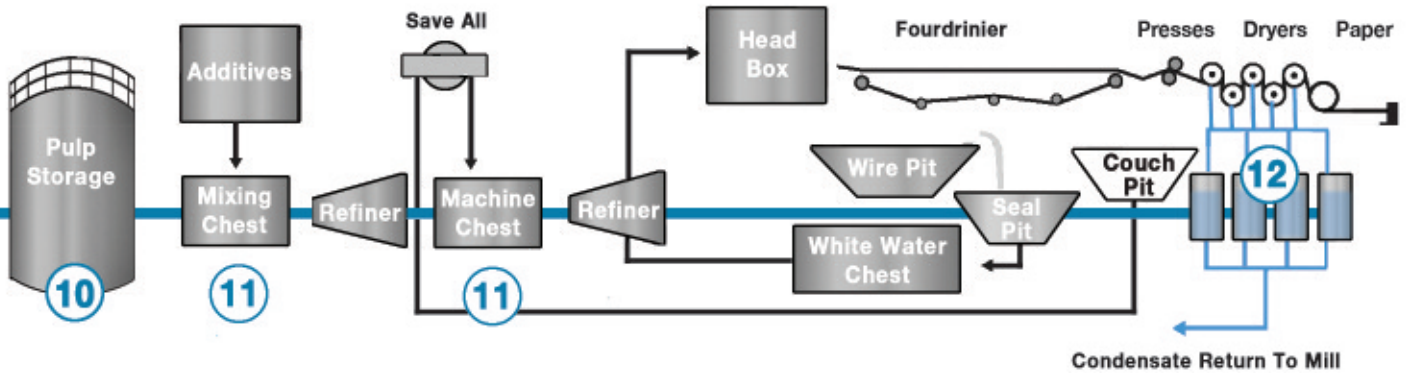
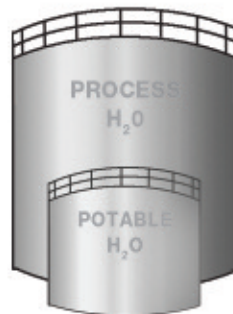
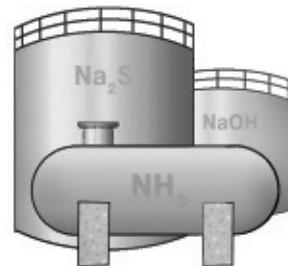
STOCK PREP**BLENDING****PAPERMAKING**

Pulp Storage

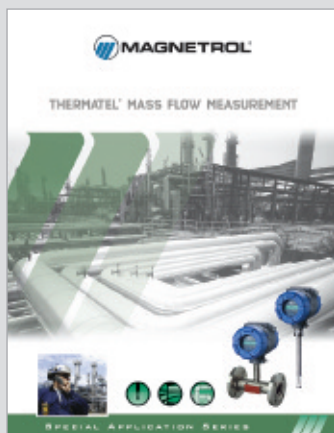
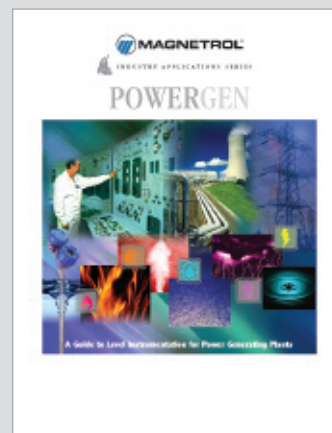
Additives Blending

Wet End

Dry End

**PLANT-WIDE****13****MC PUMP STANDPIPES****14****WATER STORAGE****15****CHEMICALS & ADDITIVES****16****LUBRICATION AND HYDRAULIC OILS**

For information on Mass Flow and Power Generation applications typically found within a Pulp & Paper Mill, contact Magnetrol® for these Industry and Application brochures.



FLOW APPLICATIONS**POWER GENERATION**

1 SOURCE WATER AND BAR SCREENS



Application: As the largest industrial user of process water, pulp and paper mills are often located next to natural water sources. Bar screens are placed in intake channels or wet wells to remove debris that could damage mill equipment. When debris has accumulated, screen cleaning is accomplished with an automated rake typically actuated by a level control mounted in an upstream channel.

Challenges: Water levels of intake channels and plant wells require monitoring. Though normally a routine application, freezing weather can cause complications for level controls, especially those that actuate screen cleaning. A level control operating in frigid, outdoor conditions must be accurate and reliable despite icing conditions.



INSTRUMENTATION		▲ Point Level: Echotel® Model 910 or 961 Ultrasonic Level Switches		▲ Continuous Level: Eclipse® Model 706 Guided Wave Radar Transmitter or Pulsar® Model R86 Radar Transmitter	▲ Visual Indication: Not applicable

2 PULP CHIP BINS AND SILOS



Application: The majority of mills make pulp stock from wood chips. Mill chippers produce uniformly sized wood pieces that pass through vibrating screens to further sort for size consistency. Chips are stored in large silos and conveyed to the chip bin where they are pre-steamed prior to entering the pulp digester.

Challenges: Level switches monitoring chip levels are designed exclusively for bulk solids. Switches monitor high and low levels, actuate filling operations, and trigger alarms in the event of plugged flow or overflow conditions. Level controls must contend with dusty atmospheres, steam, vapors, and the chips' changing angle of repose. Stable chip bin level facilitates proper pre-steaming of chips.

INSTRUMENTATION		▲ Point Level: Solitel® Vibrating Rod Level Switch		▲ Continuous Level: ECLIPSE Model 706 Guided Wave Radar Transmitter with Model 7Y2 Bulk Solids Probe	▲ Visual Indication: Not applicable

3 PULP DIGESTER



Photo by Timo Vesterinen courtesy of the Andritz Group

Application: The kraft process is the most prevalent pulping method. Here, heat and chemicals (sodium hydroxide and sodium sulphide, or White Liquor) combine in a large pressurized cooker, or digester, to transform wood chips into pulp by dissolving the wood's lignin binder. The waste lignin and spent chemicals, or Black Liquor, is routed to a recovery boiler.

Challenges: Digester level monitoring maintains operational stability, increases throughput and reduces kappa variation (the measure of lignin remaining in the pulp). Process conditions of up to +355° F (+180° C), steam, high pressure, and harsh chemicals may challenge many level sensors. Continuous level monitoring and point monitoring for overflow is a common scheme for digesters.

INSTRUMENTATION



▲ **Point Level:**
Thermatel® Model TD1 or TD2 Thermal Dispersion Switches or Kotron® Model 810 or 811 RF Capacitance Switches



▲ **Continuous Level:**
ECLIPSE Model 706 Guided Wave Radar Transmitter or PULSAR Model R86 Radar Transmitter

▲ **Visual Indication:**
Not applicable

4 DIGESTER BLOW TANK



Application: In batch digestion, the pulp and black liquor are mechanically conveyed or “blown” into an atmospheric blow tank upon completion of the cooking cycle. The tank is a large cylindrical vessel which functions as intermediate storage of the cooked pulp, and from which the pulp (now called “Brown Stock” due to its color) is discharged in an even flow to a washing process.

Challenges: Level control of the blow tank helps to maintain balance between the digestion and washing processes. Level controls facilitate on-time blow spacing in the digester while promoting improved product quality by maintaining consistent washer production and efficiency. The presence of a tank agitator will affect level control selection, which is typically a high level switch.

INSTRUMENTATION



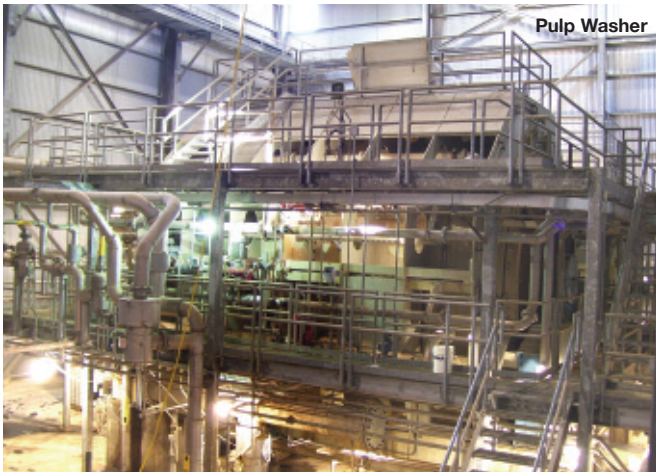
▲ **Point Level:**
ECHOTEL Model 910 or 961 Ultrasonic Switches or THERMATEL Model TD1 or TD2 Thermal Dispersion Switches



▲ **Continuous Level:**
ECLIPSE Model 706 Guided Wave Radar Transmitter or PULSAR Model R86 Radar Transmitter

▲ **Visual Indication:**
Not applicable

5 PULP WASHING SYSTEMS



Application: Pulp is washed at two junctures in the chemical pulping process. Brown Stock (pulp with residual lignin) is washed following the digester; and Bleached Stock is washed in the multi-stage bleaching unit. In each case, pulp moves through a series of washers and screens to remove residual chemicals and chips. Level controls usually monitor mass tanks and filtrate tanks in the washing units.

Challenges: Precise level control of the two pulp washing lines ensures a consistent supply of wash water; maintains level stability; ensures correct dilution levels for the wash line; keeps filtrate flows in balance; and will lessen the chemical load and possible problems in downstream processing units caused by unwashed pulp.

INSTRUMENTATION



▲ **Point Level:**
THERMATEL Model TD1 or TD2 Thermal Dispersion Switches or KOTRON Model 810 or 811 RF Capacitance Switches



▲ **Continuous Level:**
ECLIPSE Model 706 Guided Wave Radar Transmitter, Kotron Model 805 RF Capacitance Transmitter or PULSAR Model R86 Radar Transmitter

▲ **Visual Indication:**
Not applicable

6 TURPENTINE RECOVERY



Application: Vapors from the digester contain turpentine and 85% of it is released during the relief cycle. Recovery of this volatile organic compound (VOC) is undertaken for environmental reasons, to lessen effluent treatment of condensate, to utilize turpentine as a fuel source, or to sell it as a by-product to chemical processors.

Challenges: Two vessels in a typical recovery system require level control of the turpentine/water interface: the decanter, or separator, and the storage tank. The National Fire Protection Association (NFPA) rates turpentine as a "severe fire hazard." For this reason, the decanter is contained in a dyked area, storage tanks are sometimes located below ground, and controls must be rated explosion-proof.

INSTRUMENTATION



▲ **Point Level:**
ECHOTEL Model 910 or 961 Ultrasonic Switches or THERMATEL Model TD1 or TD2 Thermal Dispersion Switches



▲ **Continuous Level:**
ECLIPSE Model 706 Guided Wave Radar Transmitter or PULSAR Model R86 Radar Transmitter



▲ **Visual Indication:**
Atlas™ Magnetic Level Indicator can be supplied with switches or transmitters

7 BLACK, GREEN AND WHITE LIQUOR



Application: Black Liquor is the digester waste mixture of spent chemicals and lignin extracted from wood chips. When burned in a recovery boiler Black Liquor produces heat for steam and also releases digester chemicals called “smelt.” Mixed with water, smelt becomes Green Liquor. This is treated with lime in the causticizers to produce White Liquor, the digester’s cooking chemical.

Challenges: Stored in varying concentrations, liquors are corrosive solutions with high levels of organic compounds. Liquors can cause chemical burns or damage the lungs if inhaled. Level sensors contend with the chemicals’ harshness, variable density and dielectric, agitation, foaming, and media stickiness. Tank controls should activate the appropriate alarms or emergency shutdown systems.

INSTRUMENTATION



▲ **Point Level:**
THERMATEL Model TD1 or TD2 Thermal Dispersion Switches or Kotron Model 810 or 811 RF Capacitance Switches



▲ **Continuous Level:**
ECLIPSE Model 706 Guided Wave Radar Transmitter with Model 7XF Single Rod Probe or PULSAR Model R86 Radar Transmitter

▲ **Visual Indication:**
Not applicable

8 CHLORINE DIOXIDE (ClO₂) GENERATOR



Application: Due to health, safety and environmental concerns about dioxins and furans, the once prevalent use of elemental chlorine as a pulp bleach agent has given way to alternate technologies. Today, Elemental Chlorine Free (ECF) technologies are used for about 95% of bleached pulp production. A generator produces ClO₂ that is mixed with water for bleaching.

Challenges: Gaseous chlorine dioxide is conveyed to an absorber tower where it is dissolved in chilled water to yield the aqueous chlorine dioxide bleach solution. Maintaining continuous level in the generator is critical because the chemical material balance in and out of the generator is essential. Malfunctioning controls can create a “White Out” where bleach production ceases and a shutdown ensues.

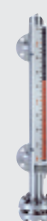
INSTRUMENTATION



▲ **Point Level:**
Series 75 Sealed External Cage Switch, Tuffy® II Float-Actuated Switch or ECHOTEL Model 961 Ultrasonic Switch



▲ **Continuous Level:**
ECLIPSE Model 706 Guided Wave Radar Transmitter or E3 Modulevel® Displacer Transmitter



▲ **Visual Indication:**
ATLAS Magnetic Level Indicator can be supplied with switches or transmitters

9 PULP BLEACHING TOWERS



Bleaching Towers

Application: Pulp leaving the digester wash unit retains a dark brown color due to residual lignin content that must often be bleached out. Bleach plants whiten pulp through three to five stages of bleaching and water washing. Typically, two pairs of chlorine dioxide and caustic extraction towers are followed by pulp washing stages.

Challenges: Bleaching operations require level controls to maintain consistent levels in the bleach towers and manage pulp flow to successive stages by controlling tower outlet valves. Application challenges include variable pulp density, temperatures over +200° F (+95° C), harsh chemicals, and the need for easy cleaning of wetted parts. A point level switch ensures overflow protection.

INSTRUMENTATION



▲ **Point Level:**
THERMATEL Model TD1 or TD2 Thermal Dispersion Switches or KOTRON Model 810 or 811 RF Capacitance Switches



▲ **Continuous Level:**
ECLIPSE Model 706 Guided Wave Radar Transmitter

▲ **Visual Indication:**
Not applicable

10 PULP STORAGE



High Density Pulp Tower

Application: Pulp stock is stored in varying densities in horizontal or vertical “chests” that are quipped with an agitator that keeps the stock in suspension. A tower is a larger vessel that provides retention time and a down/upward flow out of pulp. Because pulp can carry residual oxidants that cause corrosion of storage vessels, vessel interiors are lined with resistant materials.

Challenges: Level measurement of storage vessels is necessary to maintain a consistent supply of pulp stock to the paper machine. Pulp vessels represent a level measurement challenge due to thick and sticky media, high temperatures, steam in the vapor space, agitation, and the slightly corrosive and abrasive effects of the slurry.

INSTRUMENTATION



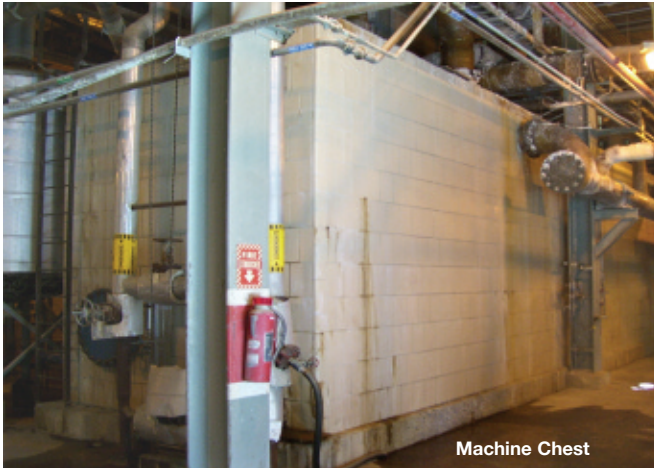
▲ **Point Level:**
THERMATEL Model TD1 or TD2 Thermal Dispersion Switches or KOTRON Model 810 or 811 RF Capacitance Switches



▲ **Continuous Level:**
ECLIPSE Model 706 Guided Wave Radar Transmitter or PULSAR Model R86 Radar Transmitter

▲ **Visual Indication:**
Not applicable

11 MIXING AND MACHINE CHESTS



Machine Chest

Application: The mixing chest is a large, agitated tank used for mixing various types of pulp, fillers, and additives together in a specified formula for the paper machine. The mixed stock is fed to the machine chest where it is pumped to the head-box and dispensed evenly onto the moving wire of the papermaking machine. When the stock is de-watered and dried, the result is finished paper.

Challenges: Level controls ensure that the chests never overflow and that the level never sinks below a safe level with respect to the agitation zone. Level monitoring must contend with pulp thickness, high humidity, and specific gravity changes. As the chest discharge operation is on level control, consistent flow must be maintained to ensure continuous papermaking.

INSTRUMENTATION



▲ **Point Level:**
THERMATEL Model TD1 or TD2 Thermal Dispersion Switches or KOTRON Model 810 or 811 RF Capacitance Switches



▲ **Continuous Level:**
ECLIPSE Model 706 Guided Wave Radar Transmitter or PULSAR Model R86 Radar Transmitter

▲ **Visual Indication:**
Not applicable

12 CONDENSATE RECEIVER TANKS



Condensate Tank

Application: Steam generated in the recovery boiler is used to run many parts of a mill. Liquor concentration and paper drying are the largest steam users, followed by digestion, bleaching, and chip steaming. (Steam also drives a turbine cogeneration system if a mill is so equipped). A steam condensate system in the paper machine's dryer section collects water for reuse in the mill.

Challenges: Steam condensate from the dryer drums enters up to half a dozen receiver tanks of the condensate return system. Level controls in these tanks ensure that water either is returned to the mill for reuse, diverted to storage, or discharged to the sewer. When the control senses the upper level in the tank it will actuate a dump valve to remove the accumulated condensate.

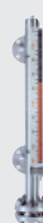
INSTRUMENTATION



▲ **Point Level:** ECHOTEL Model 961 Ultrasonic Switch, Series 75 Sealed External Cage Switch, THERMATEL Model TD1 or TD2 Thermal Dispersion Switches or Model B40 Float-Actuated Switch



▲ **Continuous Level:**
ECLIPSE Model 706 Guided Wave Radar Transmitter or E3 MODULEVEL Displacer Transmitter



▲ **Visual Indication:**
ATLAS Magnetic Level Indicator can be supplied with switches or transmitters

13 MC PUMP STANDPIPES



Application: Designed to move thick fluids, MC (Medium Consistency) pumps are ideal for transporting pulp in a mill. Pulp is often pumped from a standpipe, a vertical feed pipe integral to the pump. Pumps with standpipes typically pump to and from washers and thickeners, O₂ and ClO₂ mixers, extraction towers, bleach storage towers, and high-density pulp storage towers.

Challenges: It is important that the proper level of pulp be maintained in a standpipe. A level control in the standpipe does this by actuating a valve downstream of the pump. A malfunctioning level control could result in standpipe overflow, or cause a pump to operate in a no-flow condition in which it would quickly sustain damage through overheating and seal damage.

INSTRUMENTATION



▲ **Point Level:**
THERMATEL
Model TD1 or TD2
Thermal Dispersion
Switches



▲ **Continuous Level:**
ECLIPSE Model 706
Guided Wave Radar
Transmitter

▲ **Visual Indication:**
Not applicable

14 MILL WATER STORAGE



Application: Because pulp is processed and paper is made in an aqueous vehicle that is up to 99.5% water, water management is essential for productive mill operations. Level controls monitor the storage of cold, warm and hot process water, potable water, boiler feedwater, liquor production water, process wastewater, and open effluent weirs, sumps, and stormwater basins.

Challenges: Process, reclaimed and service water storage may range from small tanks to large bulk tanks with heights of 40 feet (12.2 meters). Controls are specified according to the size and geometry of the bulk storage vessel. Level controls in open atmosphere reservoirs must withstand punishing weather conditions. Firewater storage must conform to NFPA standards.

INSTRUMENTATION



▲ **Point Level:**
Model A15 Series
Displacer-Actuated
Switch or ECHOTEL
Model 910, 961 or 962
Ultrasonic Switches



▲ **Continuous Level:**
ECHOTEL Model 355
Non-Contact Ultrasonic
Transmitter, ECLIPSE
Model 706 Guided
Wave Radar Transmitter
or PULSAR Model R86
Radar Transmitter

▲ **Visual Indication:**
ATLAS MLI
can be
supplied with
switches or
transmitters

15 CHEMICAL AND ADDITIVE STORAGE



Chemical Tanks

Application: Chemical stocks stored in mills include acids and alkalies, delignification chemicals, bleaching agents and water treatment chemicals. Chemical additives mixed into the process stream at the wet end of the paper machine include dyes and pigments, drainage aids, defoamers, slimicides, and a broad range of specialty chemicals that improve paper performance.

Challenges: Chemical solution storage and day tanks require stringent level monitoring. Though precise chemical measurement is accomplished by metering pumps, tank level controls actuate tank-filling operations and protect against overfilling. Tank size and geometry, the presence of mixing hardware, and the solution's chemical nature are prime factors in level instrument selection.

INSTRUMENTATION		▲ Point Level: Model A15 Series Displacer-Actuated Switch or ECHOTEL Model 910 or 961 Ultrasonic Switches		▲ Continuous Level: ECHOTEL Model 355 Non-Contact Ultrasonic Transmitter, ECLIPSE Model 706 Guided Wave Radar Transmitter or PULSAR Model R86 Radar Transmitter		▲ Visual Indication: ATLAS Magnetic Level Indicator can be supplied with switches or transmitters

16 LUBRICATION AND HYDRAULIC OIL



Lube Oil Tanks

Application: Pulp and paper mills operate many machines that require lubrication. Lubricants prevent damage caused by excessive friction and prolong component and equipment life. Oil is stored in stainless steel and carbon steel tanks. While gearboxes hold up to 50 gallons, and hydraulic reservoirs up to 200 gallons, a paper machine may contain up to 5,000 gallons of lubricant.

Challenges: Level monitoring of oil reservoirs will ensure the proper functioning of pumps, gearboxes, drives, compressors, bailing presses, materials handling equipment and paper machines. Temperature shifts in oil reservoirs affect media density that excludes some technologies, such as pressure transmitters. Because ISO cleanliness levels increase oil change frequency, controls should be easy to remove.

INSTRUMENTATION		▲ Point Level: ECHOTEL Model 910 or 961 Ultrasonic Switches or TUFFY II Float-Actuated Switch		▲ Continuous Level: ECLIPSE Model 706 Guided Wave Radar Transmitter or PULSAR Model R86 Radar Transmitter		▲ Visual Indication: ATLAS Magnetic Level Indicator can be supplied with switches or transmitters



PULP & PAPER MILLS

AN INDUSTRY GUIDE TO LEVEL MEASUREMENT AND CONTROL FROM MAGNETROL

Other industry and special application brochures from MAGNETROL include:

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- **Nuclear Power**
- **Petroleum Refining**
- **Power Generation**
- **Renewable Energy**
- **Steam Generation**
- **Tank Bridle Level Measurement**
- **Tank Overfill Prevention**
- **Understanding Safety Integrity Level (SIL)**
- **Water & Wastewater**

PLEASE NOTE: The instruments recommended in these brochures are based on field experience with similar applications and are included as a general guide to level and flow control selection. Because all applications differ, however, customers should determine suitability for their own purposes.



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