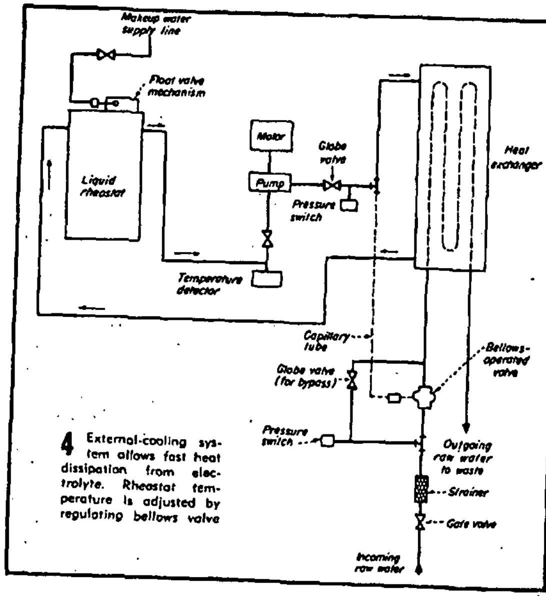
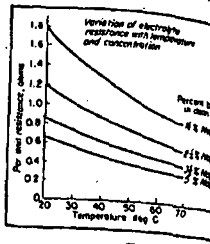


4 External-cooling system allows fast heat dissipation from electrolyte. Rheostat temperature is adjusted by regulating bellows valve



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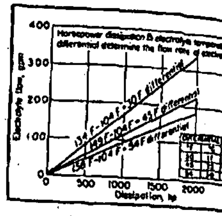


6

not included, in the graph shown above.

Curves in Fig. 5 show that at 65 C resistance is roughly 50% of that at 20 C. In other words, the electrolyte has a negative temperature coefficient of resistance.

Since the operating mechanism adjusts the gap between the electrodes to hold the required resistance, changes in resistance due to *temperature may* be compensated for automatically.

Cooling. As already indicated, heat loss in the rheostat (I^2R loss due to *flow of current*) is generated within the electrolyte itself. This energy must be removed from the electrolyte at the same rate that it is generated to maintain constant temperatures.

Fig. 4 shows a piping layout of a typical installation with external coolers. The electrolyte's *circulating pump* operates at a positive head above the intake. Since no air pockets are allowed to accumulate in the piping system at any point, sump tanks and similar devices are not required for successful operation of the rheostat.

The over-temperature relay provides protection against excessive electrolyte temperatures. A control may be used whereby the temperature of the electrolyte ahead of the cooler controls the cooling-water flow. The temperature of the electrolyte is *thus maintained at a constant value and a minimum amount of cooling-water flow is* used.

For any given horsepower dissipation, the electrolyte flow depends entirely upon the temperature differential, or difference between hot and cold electrolyte temperatures in the system. Curves in Fig. 6 show that the maximum flow of electrolyte is required for *the smallest differential in temperature.* Cooling-water flow, required by the heat exchanger to limit the temperatures between the values given, depends entirely upon the specifications of the heat-exchanger manufacturer. Approximately 11.3 gal per minute of electrolyte must be circulated per 100 hp dissipation for an average value of 25 C temperature differential between the hot and cold electrolyte.

Typical Operation. To better understand a liquid rheostat's operation, let's use it to control speed, Fig. 4, in starting and running a slipring motor:

1. Open gate valve in incoming raw-water line to provide cooling water.
2. Start electrolyte pump.
3. Raise electrode to the top or maximum gap position. This trips the interlocks *on the pulley wheel,* which in turn allows closing the primary control on the motor. The motor cannot be started unless the movable electrodes are *in the maximum resistance position.*
4. Close primary control.
5. After the motor has started, the electrodes are lowered to obtain the desired operating speed.
6. For maximum speed, the electrodes are lowered to the minimum gap (minimum resistance) position. As the movable electrodes approach the stationary ones, *mechanical stops on the* upper assembly prevent upper and lower electrodes from touching.
7. The bellows-operated valve, controlled by the electrolyte temperature from the regulator, keeps the cooling-water flow at a minimum for the desired setting of electrolyte temperature differential. Cooling-water flow varies directly with the *energy* being dissipated by the rheostat.
8. *To lower the motor speed,* the movable electrodes are raised to the desired speed setting.
9. The primary control is used to disconnect the motor from the rheostat.

Surface Water Made Fit for Boilers

Supplying all water needs for a large-scale refinery is a major problem. Esso Standard Oil Co draws its water from surface and ground wash, says A L Wilson, power-plant chief engineer, and then prepares it for corrosion-free service

WATER NEEDS at Esso Standard Oil Company's Bayway Refinery in Linden, NJ, require a soundly engineered yet highly flexible system.

Raw-water supply consists of surface waters collected in a system of retaining basins. Usual treatment for such waters involves heavy filtering. Not so at Bayway.

Here pumps pull water into a cold-storage tank from which it flows into a cold well. This point supplies power-plant cooling-water needs for generator air, bearings, oil cooling. Returns from this service join other waters from the cold well at a second well.

Pumps pull from this level to a collecting tank. This same tank receives (1) condensed flash steam from the boiler blowdown-recovery tank (2) cooling water and condensate from process (3) hot water from compressors and similar steam-driven equipment (4) intermittent excess exhaust steam passed through a barometric condenser. Average temperature of tank runs about 130 F.

Next comes the chemical-treatment or, more exactly, coagulation stage. A series of five reaction tanks, 30-ft dia x 10-ft depth, act as mixing chambers for incoming raw water and a varying amount of chemicals consisting of lime, sodium aluminate, soda ash, iron sulphate, caustic soda. Sediment, settling in bottom of these tanks, amounts to 8 to 12 tons per day.

COAGULATION PROCESS

Surface waters carry considerable finely divided and suspended matter in a colloidal state. Chemicals mentioned above speed the settling of this suspended matter. The floc or the jelly-like mass, which binds together silt, bacteria and other organic material in suspension, does not remove hardness or dissolved gases. For that reason still additional equipment stands between the water and its final service.

Actual chemical dosage varies with temperature and nature of water. Both of these vary somewhat depending on various factors like season of the year.

Usual arrangement calls for a filtering operation on water leaving the *floc-formation* tanks. Function of filtration is to clarify the water. At Bayway, however, use of five reaction tanks, scheduled cleanings, a sufficiently long stay within a tank for complete settling, all combine to give a water clear enough for plant service.

FEEDWATER FLOW

An emergency feed line connects from the outlet of the five reaction tanks *direct to boiler feed pumps.* But normal routing follows this procedure.

A pair of *deaerating tank heaters,* unique in design, stand between sedimentation tanks and boiler feed pumps. These deaerators receive normal condensate and exhaust from plant services in addition to incoming makeup water —about 80% of total.

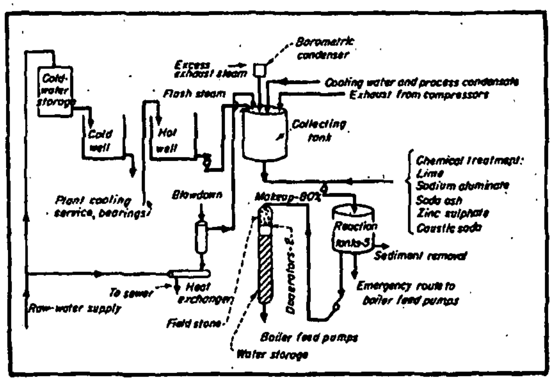
These parallel-connected tank heaters are 10 ft dia by 36 ft long. They stand on end so, carrying their normal level of water, they furnish a good positive head for feed pumps. In addition, they hold roughly a 20-min supply under usual 850,000-lb-per-hr water demands. An alarm system, which rings in both pump room and at heaters, acts as an operating precaution against a falling water level.

HEAT EXCHANGE

A very interesting and unusual deviation from general practice is loading these deaerators with field stone of about 6-in. dia. Its presence as a heat balancer plus the 20-min reserve permits water held at 212 to 215 F to rid itself completely of all dissolved gases.

This deaerating heater holds water temperature constant at the higher level with field stone as a heat-balancing medium. A larger water storage than usual plus a constant water temperature gives complete deaeration. It has paid excellent dividends.

This plant has employed steel economizers for over 25 years and has yet to lose a tube to internal corrosion. Feedwater lines, boiler parts, heaters and such auxiliaries have enjoyed the same record.



SURFACE WATER collected in retaining basins acts as raw-water supply source. Flow diagram above shows preparation stages to fit water for refinery and boiler