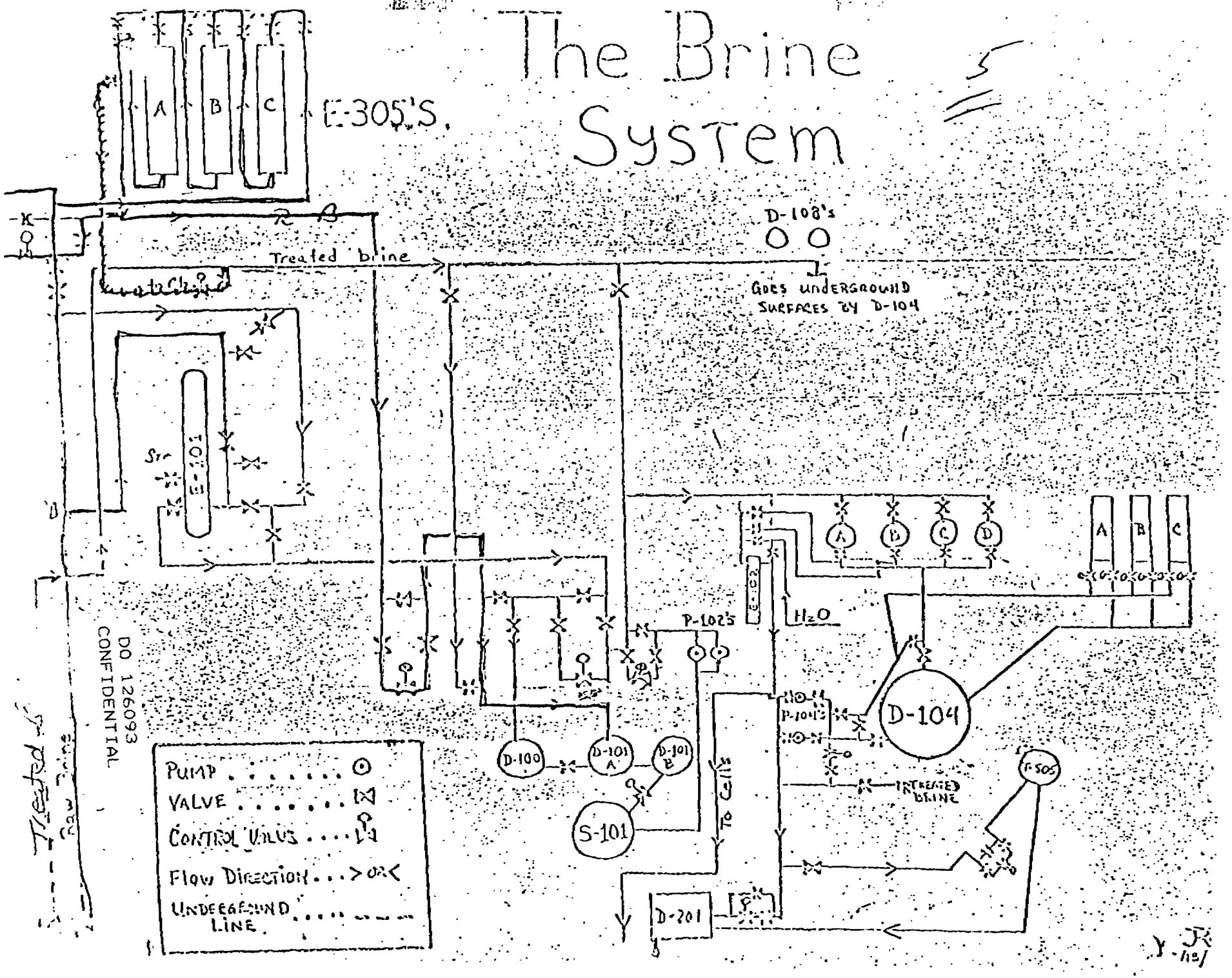
BRINE
TREATING

BRINE AND TREATMENT

Things you will learn in this section:

1. Brine Flows - see BT-1.
2. D-100 Operations - see BT-2.
3. Mix Tanks Operation - see BT-3.
4. S-101 Control - see BT-4
5. D-104 Level Control - see BT-5.
6. Head Tank Control - see BT-6.
7. Monitor and Take Readings -

The Brine System



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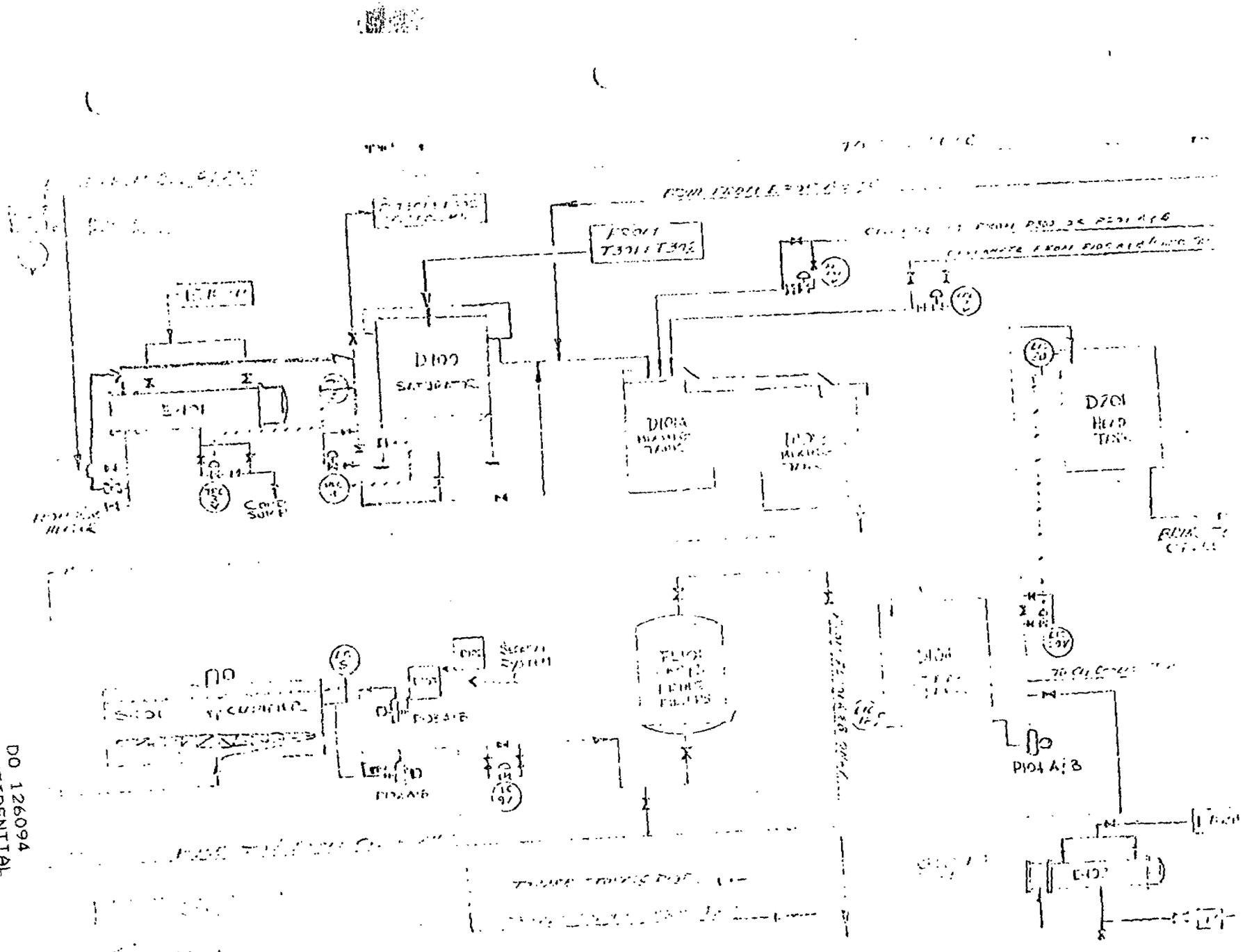

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Equipment

Saturator, D-100

a. Description

The saturator is a conical vessel 17' I.D. and 23'9" long designed for 200°F and full of liquid. The operating temperature will be about 100 - 105°F. The capacity of the saturator is approximately 17,200 gallons when full. This is a rubber lined steel tank.

b. Instruments

(1) WRC - 4 - controls weight of the tank by changing water flow.

(2) PHRC - controls excess caustic in outlet by adding HCl.

c. Operations

This saturator is a conical vessel which is used to dissolve solid salt coming from our caustic plant. Brine made in D-100 is treated in the mix tanks (D-101s) and recycled back to the cells.

Salt to D-100 comes from three places:

(1) T-301 - big salt column

(2) T-302 - small salt column

(3) D-108s overflow tank - salt slurry storage tanks

All the salt lines enter the saturator from the top and discharge about 6 - 8 feet under the liquid level. Water is added at the bottom. As water flows to the top, the

Saturator, D-100 - Cont'd.

salt is dissolved. Saturated brine overflows into a trough on top of saturator and flows to the mix tanks.

The concentration of brine in D-100 is controlled by holding constant weight of the tank. Since liquid overflows from the saturator, the tank always has a constant volume in it. The legs of the tank seat on weigh cells that measure weight of D-100 and its content. This weight is set to 0 pounds when saturator is empty. When D-100 is filled with water, the weight recorder will show approximately 143,000 pounds. Since saturated brine is 1.2 times heavier than water, D-100 full of brine will weigh about 171,000 pounds.

To make sure that brine coming out of D-100 is always saturated, we keep some solid salt at the bottom of the tank. This salt adds extra weight to the tank. We run the weight controller at a set point of 175,000 pounds. The weight controller controls an automatic valve on the water line to D-100. If weight goes above the set point, water valve will open adding more water and thus dissolving more salt. If weight drops below the set point indicating that we do not have enough solid salt in the tank, water valve will close.

Saturator, D-100, Startup

Normally the saturator will not be placed into service until the Caustic Plant has been started up.

Safety:

1. Wear monogoggles, hard hat, and boots. Have respirator handy.
2. Use proper tools.
3. Watch for caustic, steam, condensate, and HCl leaks.

Procedure:

1. Open saturator dump valve.
2. Start a flow of salt slurry from the salt columns, T-301 & T-302, to the saturator. (Refer to Salt Column Startup Procedure)
3. Start a flow of water through E-101 to the saturator when the flow of salt slurry starts and set the weight of the controller, WRC-4 at 165,000 pounds.
4. The bypass around WRC-4 may have to be cracked and maintain a water flow of approximately 100 gpm until saturator overflows thru dump valve open until the system lines out. The specific gravity of the brine in D-100 should be approximately 1.197 at ambient temperature.
5. Close bypass around WRC-4 and line out controller.

   NOTE: Be sure that the salt slurry from T-301 and T-302 does not have too much caustic in it.

Saturator, D-100, Start-up

Procedure:

6. Open block valves.

7. Close saturator dump valve. This will allow brine to flow into D-101A trough.

8. Change set point on WRC-4 to 175,000 pounds, controller should hold this setting.

Saturator, D-100, Shutdown

If the caustic plan shuts down, or maybe for some other reason, the saturator will have to be shutdown.

Safety:

1. Wear monogoggles, hard hats, boots and respirator.

2. Use proper tools.

3. Watch for leaks such as caustic, steam, condensate, and HCl.

Procedure:

1. Stop flow of salt slurry to saturator from salt columns, T-301 and T-302. (Refer to T-301 and T-302 shutdown procedure.)

2. Close water inlet valve to saturator.

3. If it is necessary to drain the saturator, open the 6" drain valve on the bottom of the saturator and wash the inside of the vessel with water.

4. Close the steam valve to E-101.

5. Close the water inlet and outlet valve on E-101.

Equipment

Mix Tanks, D-101 A and B

a. Description

The mix tanks are 15' O.D. by 24' high vertical tanks. Each mix tank has an agitator, A-101 for D-101A and A-102 For D-101B. Capacity is about 30,000 Gallons.

The two mix tanks are connected by a trough into which the treating chemicals and brine are fed.

b. Instruments

1. AR-5, AMP recorder for agitator, A-101.
2. AR-6, AMP recorder for agitator, A-102.
3. FRC-7, Flow recorder controller for carb feed to mix tanks.
4. FRC-151, Flow recorder controller for cell effluent feed to mix tanks.
5. TR-190-1, Temperature recorder for brine from mix tanks.

Operation

D-101 A and B

Before raw brine can be sent to the cells it has to be purified. There are four major impurities in the brine that are taken out in brine treating

1. calcium Ca^{++}
2. magnesium Mg^{++}
3. ammonia NH_3
4. organics

not taken out calcium and magnesium will plug the diaphragm in the cells. Ammonia will react with chlorine in the cells and form nitrogen trichloride (NCl_3). This compound is very explosive if it accumulates even in small quantities. Organics fed to the cells with brine will cause foaming in the cells which could cause chlorine spills.

To remove all these impurities raw brine is sent to the mix tanks (F-101 A & B) where chemicals are added to treat the brine.

1. Sodium carbonate (Na_2CO3) is added to remove calcium. It reacts with soluble calcium in the brine and forms a solid (calcium carbonate) that can be separated from brine later in the process.

   $Ca^{++} + Na_2CO_3 \longrightarrow CaCO_3 + 2Na^+$

2. Sodium hydroxide (NaOH) in the form of cell effluent is added to react with magnesium. Again, a solid is formed (magnesium hydroxide) that can be separated later.

   $Mg^{++} + 2NaOH \longrightarrow Mg(OH)_2 + 2Na^{++}$

3. To remove ammonia, chlorine is sparged into the cell effluent line going to the mix tanks. Two reactions take place. First, chlorine reacts with cell effluent to form sodium hypochlorite (NaOCl).

   $Cl2 + 2NaOH \longrightarrow NaOCl + NaCl + H_2O$

   In the second reaction sodium hypochlorite reacts with ammonia to generate Nitrogen gas which is given off in the mix tank.

   $NH_3 + NaOCl \longrightarrow N_2 + NaCl + H_2O$

4. Sodium hypochlorite also reacts with organics to convert them to carbon dioxide (CO_2) gas and some chlorinated organics which are removed with solids in the clarifier.

CLARIFIER S-101

Description

The clarifier is a Dorrco 65' diameter Type "W" Hydro-Treater. The clarifier is designed to remove from the brine the impurities of calcium, magnesium, and any other suspended matter. The function of the unit is to collect the impurities in solid form and remove them as a heavy sludge.

The equipment consists of a steel tank, S-101, with a center drive mechanism, A-103, on which rotating distribution arms are attached. Raking blades are provided on one pair of the four distribution arms for moving coarse material that settles on the bottom toward the central annular pocket from which is is withdrawn through the sludge pipe, using P-212A or B and pumping to the ditch. The drive head is mounted on top of a center column resting on the tank floor and supports a center drum to which are attached the feed distributing arms. Rectangular feed troughs with drop pipes are attached to the rotating arms. The influent pipe is located below the tank bottom connecting to the central opening. The brine flows to the feed distributing arms and out through the drop pipes into the tank. The effluent is discharged over a V-notch wier into the effluent launder at the top of the tank.

Operation

The brine entering at the bottom of the clarifier through the rotating arms is immediately brought into contact with a sludge

blanket created by holding previously formed sludge in suspension. Intimate contact of the new particles of the sludge blanket results in the formation of a readily settleable floc. To aid in forming this floc, Percol 511 is metered by P-103A into the inlet of the second mix tank at the rate of .1 ppm by weight.

The method of introducing the brine brings about a uniform vertical velocity, without short circuits, over the complete area of the tank. The tank is designed so that at rated capacity this vertical velocity is considerably less than the gravitational velocity of the calcium and magnesium compounds. The brine depth is selected to insure complete clarification of the brine before overflowing the effluent wier. The action of the center scrapers in the center sludge well brings about a moisture reduction of the sludge preparatory to drawing off. The thickened sludge is continuously discharged from the sludge well by a pump which sends it to the ditch. Removal of the sludge is maintained at a rate whereby the amount of solid material discharges is equal to the potential quantity present in the brine feed. Grit or other coarse crystalline precipitate which is too heavy to stay in suspension is conveyed by the raking blades along the tank floor and delivered into the sludge hopper.

The sludge (95-98%) off the bottom of S-101 is picked up by the P-212 pumps where it is pumped to ditch.

Brine overflows into a level controlled box on the side of S-101. P-102 takes suction from this box and discharges thru a control valve. The brine temperature at the clarifier should be at about 100°F ± 5°F. The pH to the clarifier should not be lower than 10.5 pH. Temperature, pH and air will cause an upset in the clarifier, milky color, rolling, etc.

The brine at the top of the clarifier should be clear.

Trouble-Shooting

1. Foreign objects dropped into clarifier - Stop rake mechanism (at slowest speed) and fish foreign object from clarifier. Do not overload rake motor.
2. Clarifier overflow cloudy. Underflow sludge too thick. Open sludge valve and decrease solids in sludge.
3. Underflow sludge too thin. Reduce sludge flow to sewer.
4. Underflow sludge line stopped up. If the underflow sludge line to sewer plugs, connect a water hose to the sludge line water connection and flush water into clarifier and into pump, by opening and closing the clarifier underflow valves.
5. Sludge blanket samples getting lighter. If the sludge blanket samples start getting lighter throughout the entire blanket, this indicates that the rake mechanism speed is too slow and should be increased.
6. Overload alarm, UA-8, sounds. The most common cause of overload is excessive depth of settled solids, but frequently the overload can be traced to some object in the tank obstructing or wedged under the raking arms. The cause of the overload should be thoroughly investigated and eliminated, as any attempt to operate the rake drive mechanism in this condition may seriously damage the machine.

Equipment

Clarifier, S-101, Startup

Safety:

1. Wear monogoggles, hard hats, and boots. Have respirator handy.
2. Use proper tools.

Procedure:

1. Check inside of clarifier and make sure that all foreign objects have been removed.
2. Start a flow of brine to the clarifier, S-101, by letting the mix tank, D-101B, overflow into the mix tank overflow trough and then into the clarifier. The flow should be approximately 800 GPM.
3. Start the drive mechanism for the clarifier agitator, A-103, at the minimum speed setting. NOTE: The agitator should have been set at the lowest speed prior to the previous shutdown due to the fact that the speed can only be changed while the unit is in operation. It is necessary to start the unit in low speed in order to obtain maximum torque.
4. Check the drive mechanism load on the ammeter recorder, AR-8, to make sure that the rakes are not overloaded or dragging.
5. When the level in the clarifier approaches the overflow point, start removing sludge from the sludge well. Adjust the sludge valve to control the sludge thickness at a 95% level after settling for 10 minutes in a 1000 ml. graduated cylinder.
6. Adjust the speed of the clarifier rake mechanism to obtain an almost clear overflow effluent and approximately a 95% sludge

level of the drain sludge. The setting should be approximately 2 on the dial.

5.b Clarifier, S-101, Shutdown

The shutdown of the brine treating system for an extended period will usually require the shutdown of the clarifier. Also, the clarifier may sometimes have to be shutdown for maintenance reasons.

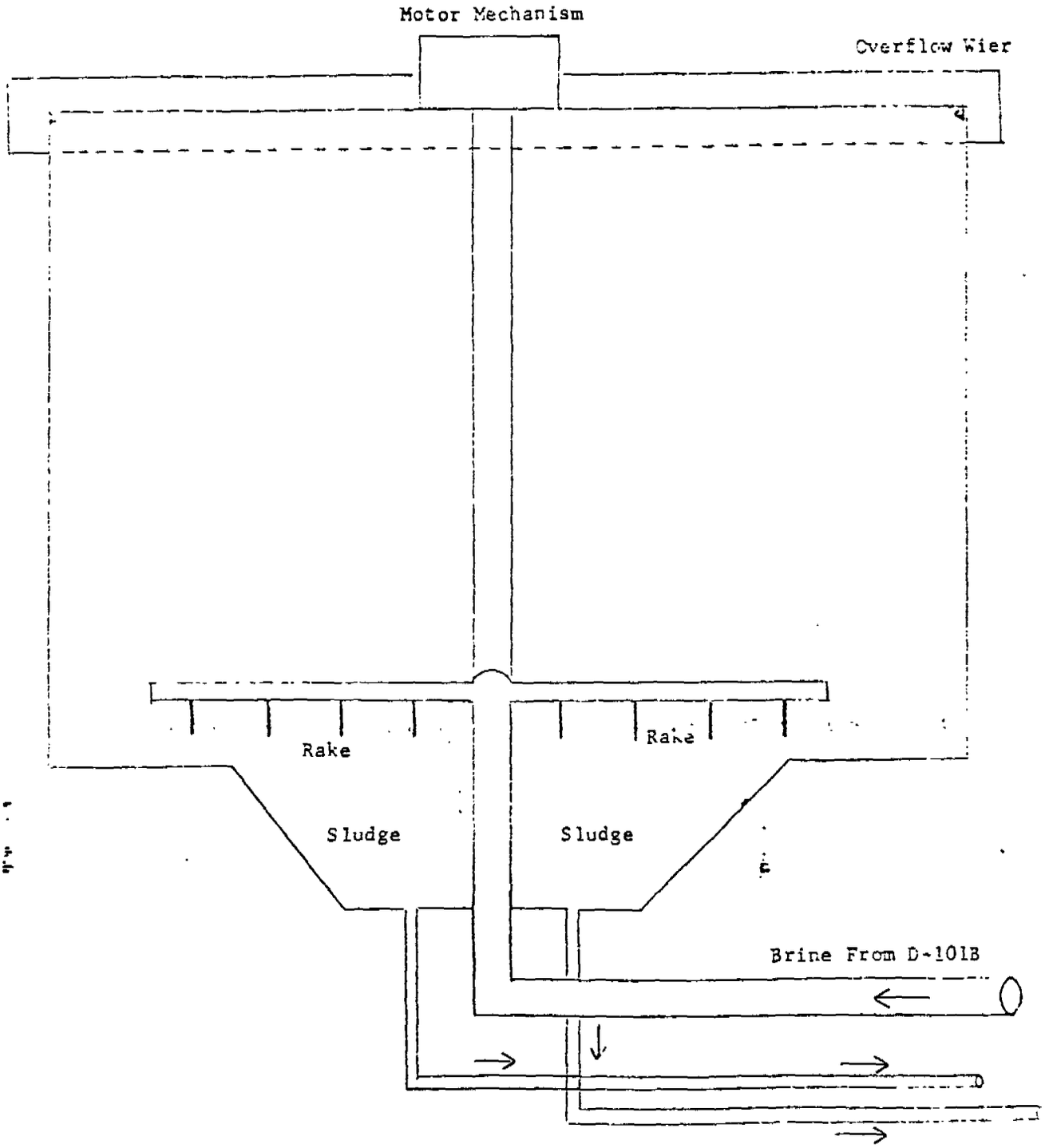
Safety:

1. Wear monogoggles, hard hat and boots. Have respirator handy.
2. Use proper tools.

Procedures:

1. Stop the flow of brine to the clarifier by stopping the flow of brine to the brine treating system or opening the drain valve on D-101B and letting the brine drain to the ditch.
2. Stop flow of percol to system.
3. Slow down the clarifier drive mechanism to its lowest speed.
4. Stop drive mechanism.
5. Drain clarifier and wash with water if necessary to perform maintenance on inside.

S-101



Brine comes in thru incoming line from D-101B into rake mechanism where thru nozzles the brine is dispersed.

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D-104, Brine Storage Tank

The brine storage tank is a 50' diameter by 30' high open top steel tank designed for 1.25 specific gravity liquid at 200°F. Operating temperature will be approximately 100-110°F.

The tank will hold 440,000 gallons of brine when full. This volume is about a 4 hour supply of brine for the plant when operating at a nominal capacity of 1,880,000 pounds of chlorine per day.

The tank level is controlled manually by varying the amount of raw brine entering the plant from the Chlorine Plant.

D-104 has 2 pumps on it - P.104A and B. P-104A and B pump brine from D-104 to D-201. Also P-104A and B pump treated brine to C12 plant and through T-505 to D-201. D-104 level should be maintained at 90% full to allow for maximum running time in the event we would lose our raw brine make-up.

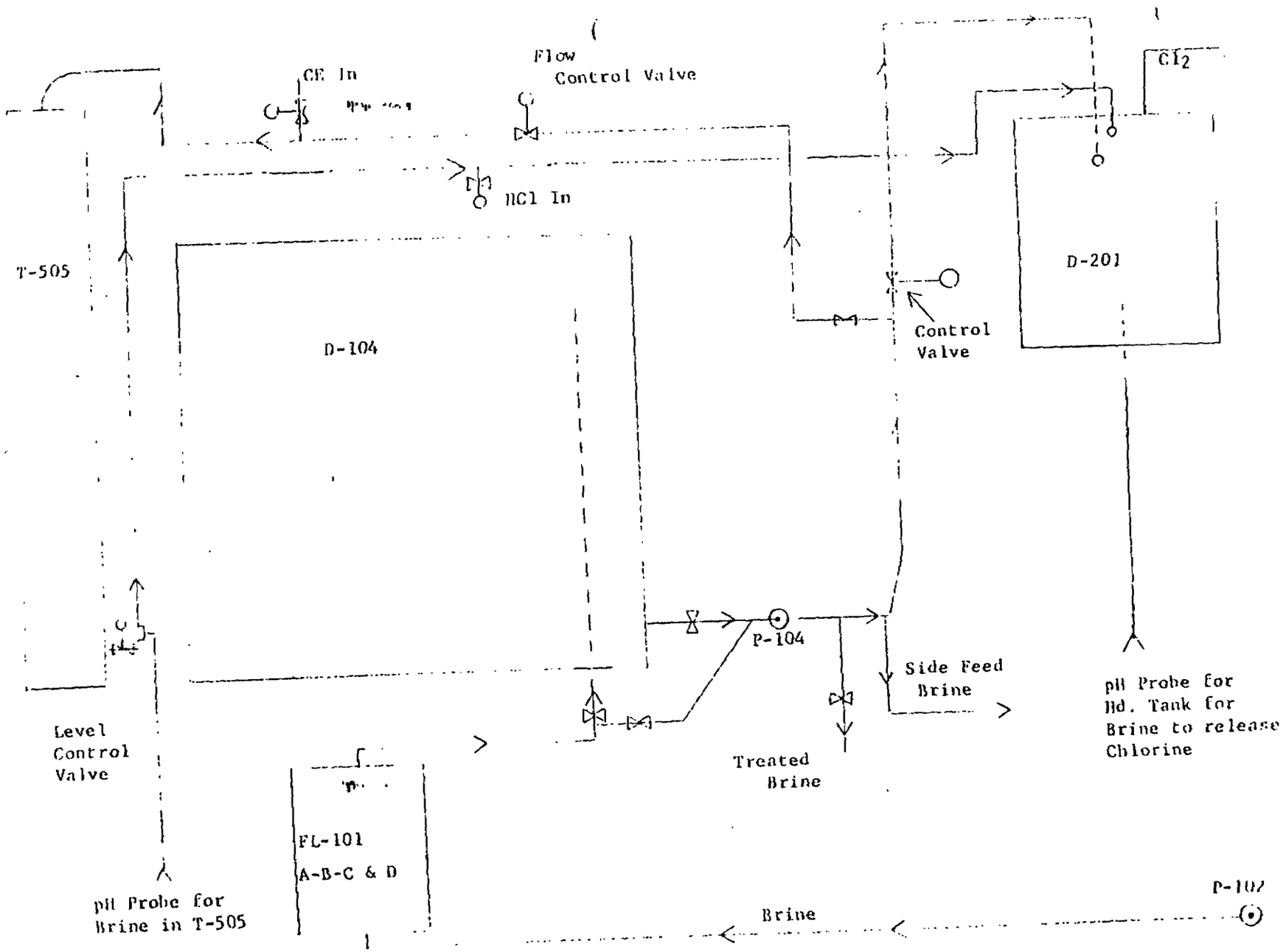
D-201, Brine Head Tank

The brine head tank, D-201, is a vertical, plastic tank 11'10" in diameter by 20' high. At normal operating level, midway between the high and low level alarm probes, the tank holds 15,400 gallons of brine or a 8½ to 9 minute supply of brine for the cells when the plant is operating at rated capacity. The tank has a level controller, LIC-20, which controls brine feed to the tank and High and Low Level Alarms, UA-21 and UA-22, in the brine alarm panel, ANN-4, on control board CB-4.

D-201 is vented back to Cl_2 drying.

T-505, Brine Column

A side stream of brine of about 600 gpm is sent to T-505 before it enters D-201 and then returns to the top of D-201. This brine is routed through T-505 when T-505 is in service. The pH is controlled between 5 and 6 pH on T-505 outlet. The pH at the head tank is controlled at approximately 2.0 pH before it goes to the cells. By injecting HCl in the line, brine flowing through T-505 absorbs Cl2 from the tail gas. pH is dropped to approximately 2.0 pH at the head tank to release the Cl2 which goes back to the drying train.



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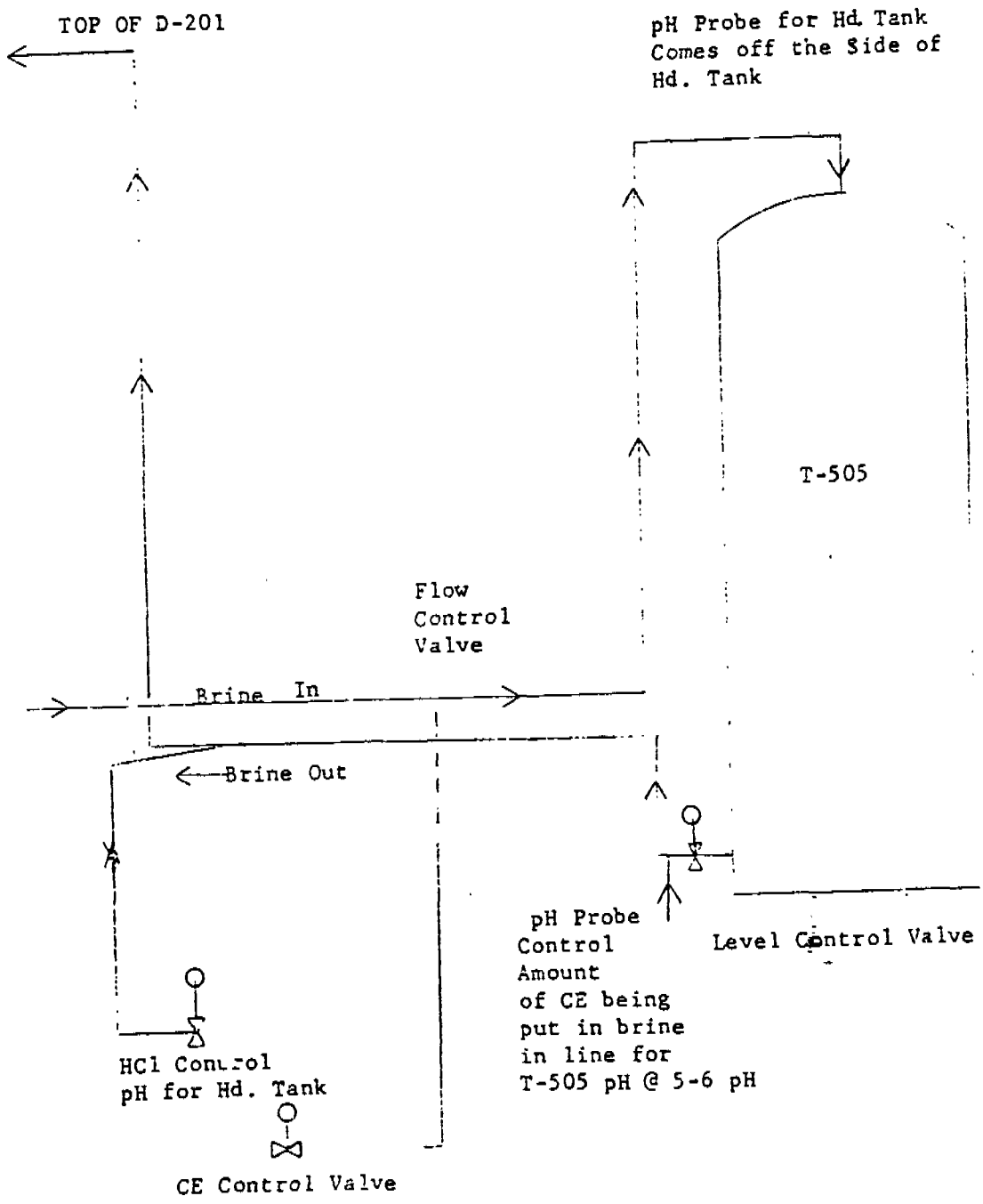

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