

EQUIPMENT SPECIFICATIONS - JOB NO. 79-506C

SCHENK Model ZHF-SR-20-KL (2 EACH)

All interior metal surfaces of the filter are made of 316L stainless steel, with #4 finish internally and externally.

Design Pressure - 75 psig
Design Temperature - 300°F
Effective filtration area - 209 ft² per filter

Construction Details

32 plates

Distance between Plates - 1.25 inches
Filtration Screen Mesh - 80 micron
Maximum Cake Capacity - 22 ft³
Effective Cake Capacity - 17 ft³

PRINTS TO - DYNA-GEL, INC.

402361-A08 (F-201B)	General Assembly
402361-A07 (F-201A)	General Assembly
402310-B07 (F-201B)	Vessel Assembly
402310-B06 (F-201A) ^A	Vessel Assembly
402322-A23 (F-201B)	Lower Bearing & Seal Assembly
402322-A22 (F-201A)	Lower Bearing & Seal Assembly
302353-A22 (Both)	Filter Shaft Stack Assembly
302354-A26 (Both)	Upper Bearing & Seal Assembly
302337-B02 (Both)	Drive Assembly
402328-A26 (F-201B)	Seal Flushing Assembly
402328-A25 (F-201A)	Seal Flushing Assembly
302345-C01 (Both)	Filter Plate Assembly
302345-A09 (Both)	Filter Plate Assembly

1. GENERAL DESCRIPTION OF THE PROCESS

NOTE: SEE REFERENCES TO ITEM NUMBERS REFER TO DRAWING D79506-1
ENGINEERING FLOW DIAGRAM.

Two type ZHF-SR-20-KL Centrifugal Self-Cleaning Filters (F-201A and F-201B) are provided complete with precoat tank (T-203) and pump (P-203), body feed tank (T-202) and pump (P-202), automatic valves (AV's) and feed pump (P-3). (Refer to purchase order and quotation for other auxiliary equipment provided.) The system is designed to allow filtration of approximately 33^x GPM of 5% - gelatin solution using either one or both filters at a time. A remote control panel is provided to allow remote operation of the automatic valves (refer to drawing 600231-A01). For best operation, the filters should be precoated with filter aid, then an amount of filter aid should be added to the feed stream as body feed. After the filter cake maximum volume is reached, then the filter is blown down, the cake is discharged and the filter is backwashed. The filter is now ready again for precoating and filtering.

2. GENERAL DESCRIPTION OF FILTER

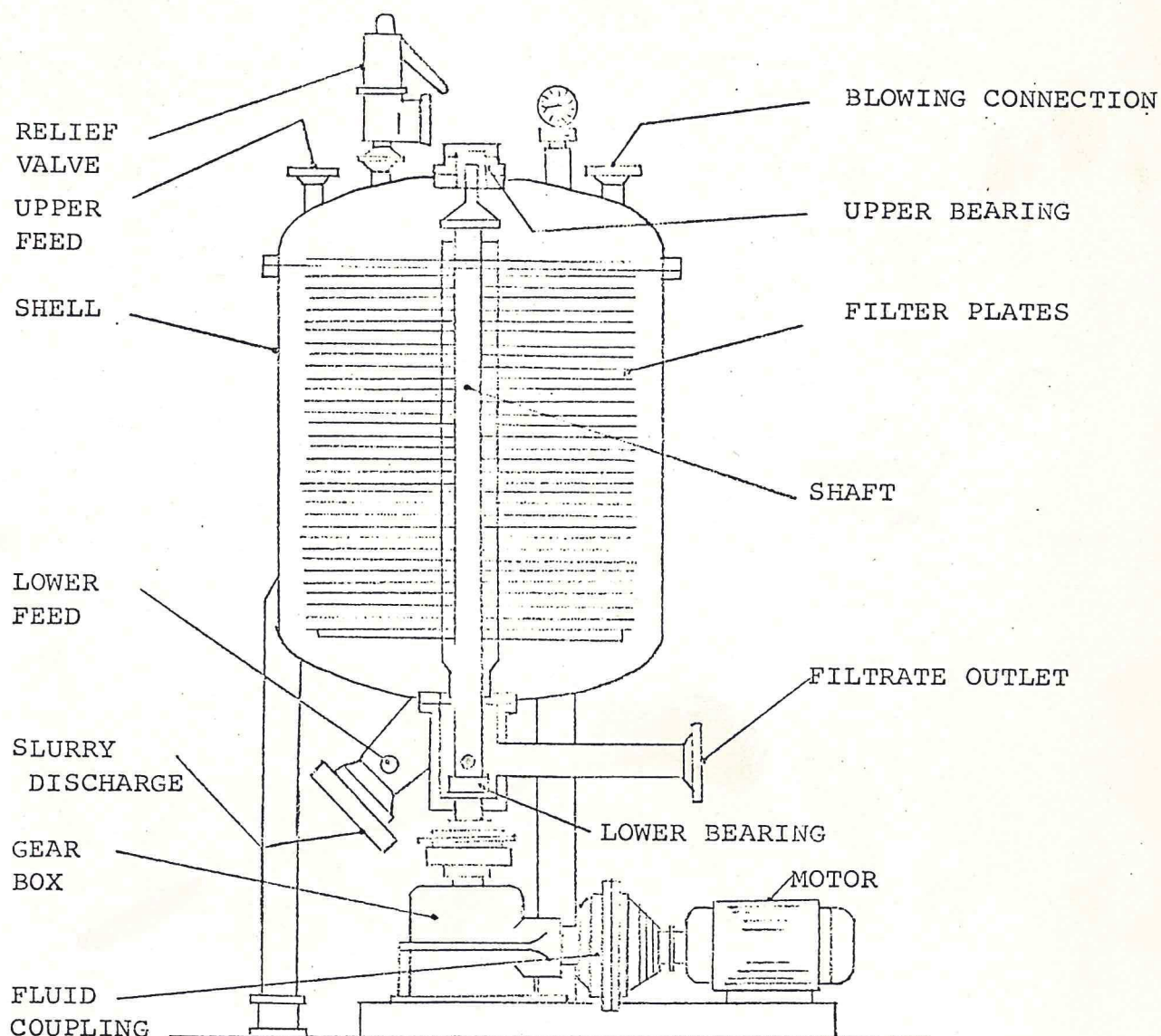
S Type, Slurry Discharge Fig. 1

The Centrifugal Self-Cleaning Filter consists in general of a pressure vessel of the desired material of construction. Inside this vessel is a hollow shaft equipped with circular filter plates in the horizontal plane.

The filter plates are provided with woven metal screens.

A layer of filter aid is first coated on the plates and, depending on the types and quantities of the material to be filtered,

FIGURE 1
MODEL ZHF-S



additional filter aid may be injected during filtration as body feed. The addition of filter aid, during filtration is not always necessary and in some cases clarification is possible without any filter aid, the solids being removed by formation of a filter cake from the solids themselves.

Cleaning of the filter is effected by backwashing and simultaneous rotation of the filter plate stack. Rotation is obtained by direct drive to the hollow shaft by an electric motor through a gear box. The residues are removed by centrifugal force in the form of a slurry through a large bore slurry discharge connection.

3. GENERAL

IMPORTANT - ON RECEIPT OF FILTERS:

Please check contents against Delivery Papers and Equipment List. Chemetron Process Equipment should be notified immediately of any missing parts. Check immediately if parts are damaged and notify Chemetron for the purpose of claims against the carrier, etc., including any damage to cases or packing.

The Centrifugal Discharge Filter is shipped partly dismantled, and in order to guarantee correct functioning it is recommended that the initial start-up be carried out under the supervision of one of our engineers, otherwise we reserve the right to reject claims under mechanical adequacy and correct mechanical functioning, within our warranties.

4. ERECTION OF THE FILTER

Before delivery the filters are aligned and tested in the plant, then dismantled for shipment. Motor and gear box assembly will have been set up and the bolt holes drilled for correct positioning and tolerances. Refer to Assembly Drawings.

However, final alignment must be carried out on site and the procedure is as follows:

- a) The complete filter is placed on a level surface. It is recommended that the filters, etc. be mounted above the normal floor level and that grouting be provided to prevent water, dirt etc. from accumulating under the mounting plates; thereby causing the mountings to rust prematurely.
- b) The whole vessel should be plumbed absolutely level. The bottom face of the flexible coupling half attached to the filter can be taken as reference. Ensure orientation of the solids discharge connection, etc., is as per detailed drawings.

Bolts should be attached at this stage so that they drop in their grouting holes.

- c) The drive unit is placed in position complete on its base frame and correctly orientated. It is lifted by the jacking bolts provided and shims if necessary until it is level and the face of the flexible coupling is 0.15 to 0.25 inches from the upper coupling face. This distance to be equal in all positions around the coupling. The drive bolts and rubber inserts can now be inserted in the coupling.
- d) Grouting should now be completed.
- e) The fluid drive coupling should be set up in accordance with the manufacturer's separate instructions (attached). This must be done after the drive frame is firmly set.

In cases where setting in concrete is not possible, the filter should be anchored to steel girders, and the Chemetron Service Department should be consulted on structural details in such cases. Allowance should always be made for unbalanced forces acting in an upward direction through the feet of the filter as a result of the uneven loading of plates with cake during the centrifugal discharge operation. Such oscillation is transferred to the base frame work.

5. ASSEMBLY OF THE FILTER PACK

The filter is shipped from the plant with shaft in normal position, without the plates, spacers, etc., which are separately packed, to avoid damage in transit. Remove all main flange bolts and lift the lid by means of lifting tackle or the hydraulic jacking system. Remove the hollow shaft (ensuring a clean vertical lift, see also under "Maintenance" for further details) in order to check the seals within the outlet and seal housing. When reinserting be sure that the shaft fits correctly in its gland and that the driving dog in the lower driving stub shaft engages correctly. Without the steadying effect of the upper bearing, the shaft can be moved back and forth slightly. All components must be perfectly clean before assembly. Start assembly (see drawing no. 302353-A22) by first fitting the scraper ring assembly to the main shaft checking that a gasket is fitted on both sides. The driving pins of the shaft should engage in the corresponding slots of the support spider shoulder. Assembly of the filter plates follows, checking that a gasket is placed between each component (i.e. bottom of each spacer ring). Wet each gasket in filtered fluid or water before fitting. This will help bedding down when pulling the stack up tight later. Always be sure that plates are fitted with filter weave uppermost. The lowest plate is the one without a spacer welded to the underside. All other plates are interchangeable.

DO NOT USE SEALING COMPOUNDS ON GASKETS.

CHECK THAT EVERYTHING SEATS CORRECTLY.

Any foreign matter or doubtful sealing material could lead to minute gaps with consequent passing of solids.

After all the filter plates have been mounted, the baffel (a blank plate the size of a filter plate) and the compression assembly, made up of thrust collar with "O" Ring in its bore, compression nut, and bolts are assembled.

Turn the compression nut down as far as possible, then tighten the jack screws. The latter are given one half turn at a time to ensure even tightening of the pack, until tight. Do not use extension wrenches or extreme forces in tightening.

IMPORTANT

WHERE NEW FILTERS ARE ASSEMBLED, THE PLATES AND GASKETS MAY LOOSEN AND THE FILTER PACK SHOULD BE CHECKED AND RE-TIGHTENED AFTER ONE TO TWO DAYS' OPERATIONS.

6. TOP BEARING ASSEMBLY

Drawing 302354-A26 shows the top bearing assembly. To increase tension on the filter pack, remove the bearing assembly and tighten jack screws by reaching through flange that holds the bearing assembly, or remove to head.

7. SEAL FLUSHING ASSEMBLY

D79506-1 shows the (AV-10 and AV-21) flushing connection with an automatic valve, feeding pressurized hot water to the lower seal housing. This fluid, when the valve is opened, enters the openings in the seal housing, pressurizes the seals and prevents unfiltered fluid or solid particles from entering the seal while the filter is spinning. The hot water should be fed at 10 to 20 psig. The valves are activated by the appropriate switch on

the control panel.

The automatic valve provided to control the flushing seal should be operated so that it is fully open before the drive motor is started, to permit pressurizing and flushing of the seals before and during rotation of the filter stack. The valve should be left open for 3 to 5 minutes after the motor is turned off, or until the shaft has come to a complete stop, whichever occurs first.

The manual valves in the seal flush line allow for checking seal leakage.

8. ELECTRICAL CONNECTIONS

Cables and all other electrical equipment should be installed by a qualified electrician.

9. DRIVE ASSEMBLY

The filters are equipped with fluid couplings. Check that they are filled with the correct oil to the correct level, as per manufacturer's specific instructions attached. Fill level is critical since it determines the amount of slip, and therefore rotational speed and current draw fill level should not be altered without contacting the Chemetron Service Department.

The coupling is fitted with a fusible plug to guard against damage by overloading and overheating. Never exchange this plug with a normal plug or bolt.

The flexible coupling should be checked for play - faces should be parallel approximately 3/16" clearance. This coupling not only takes up any possible change of alignment occurring if the filter vibrates under load during spin, but also simplifies removal of the drive for maintenance purposes on the lower end of the driving shaft assembly.

A right angle, helical, spiral bevel gear reduce is supplied. Check for correct oil level and check manufacturer's instructions attached.

10. PIPE CONNECTIONS

Refer to flow sheet attached (drawing no. D79506-1). This illustrates the valve, system lay-out. Filters are normally fitted with pressure relief valves. The relief line should not be restricted and should pass to a suitable receiver (e.g. returned to feed tank). Gelatin and precoat slurry is fed to the filter at both top and bottom with hand valves on each branch to control flow distribution. An approximate 75% top to 25% bottom ratio should be maintained. Hand valves need only be set once and are backed up by a single on/off feed control valve, which is remote operated.

Allowance should be made when installing pipework to the flanges at the upper end of the filter for the filter lid to be lifted off for routine inspection, or maintenance, and the pipe work so installed to minimize work in breaking flanges. (Consult Chemetron drawings attached.)

If the filtrate receiving vessel is below the level of the filter to any marked degree, arrangements should be made to avoid syphoning from the filter, e.g. by means of a riser and break box.

Care should be taken during erection that heavy valves and pipe connections are supported independently so that their weights do not distort the filter connections, or flanges during dismantling and assembly. The design of the various valves should comply with the maximum operating pressure specified for the filter. Remember that allowance should be made for vibration. Consult Chemetron piping drawing attached.

The drain line is connected so that the unfiltered liquid heel will be taken back to the feed tank.

It is up to purchaser to decide whether chemical cleaning lines should be separate from product feed lines, to avoid contamination, etc.. Be sure, however, that there is adequate size to cover rate of flow (in forward, i.e. filtration direction) and pressure, which should be at least 25G/sq.ft./hr..

11. START-UP (PRECOAT FILTER)

a) Preparing the Precoating Solution

Precoating is carried out with hot water, in which the filter aid is suspended (consult filter aid supplier for recommended grade). Fill the precoat tank (T-203) with water by opening valve AV-2 (AV-2 will close when LS-2 detects the water level.) Add 40# of filter aid to the

tank and start agitator AG-2. Fill the filter to be precoated with hot water by opening the proper valves (AV-16 and AV-13 for F-201A and AV-17 and AV-23 for F-201B). When the vessel is full, water is seen flowing through SG-1, close the valves. The vessel is now ready for precoating.

b) Precoating

→ Open valves AV-30, AV-15 and AV-6 for precoating F-201A (AV-30, AV-18 and AV-25 for filter F-201B). Start pump P-203. Continue precoating until the water in the precoat tank is clear. Close the valves and stop the pump. The filter is now ready for use.

c) Body Feed

If body feeding is needed (as is the most likely case) fill the body feed tank with hot water by opening AV-1 (AV-1 will close when LS-1 detects the water). The amount of body feed required depends on the kind and amount of turbidity present in the product. European experience indicates that 0.01 to 0.02# filter aid per pound of dry gelatin is sufficient. Tests must be made to determine the exact requirements.

d) Feed

The feed pump is a sanitary centrifugal type which means it will have a variable output depending on the head it sees. To insure a constant feed rate the back pressure on pump must be maintained even though the differential pressure across the filter is changing. This can be done by controlling the flow with the flow control valve (unnumbered valve connected to LIC-1). Flow indicators are included on the discharge of the filter to tell what the

2
Need to fill
vessel w/ water 1st

1st
↓ OPEN VALVE BACK OF TK

AV-30
OPEN
PUMP
WITH
MOTOR

#3 DEF
V-30
V-34
V-41
V-36

flow rate is at a given time. An approximate flow rate can be determined by the pump performance curve included (for pump P-3). This shows approximately 40 GPM at 80 psig backpressure. The body feed pump (P-202) is a piston diaphragm type with an infinitely variable, manually adjustable output. Once this pump output is set, its output should be constant for whatever backpressure it sees. The success of the filtration depends on controlling the ratio of body feed to feed at the proper conditions. Too much or too little body feed causes the following problems:

Not enough body feed

In this condition, the cake will "seal over" because of low porosity. The feed pressure will quickly rise to or near "dead head" pressure and flow rate will approach zero.

When this occurs the operator must stop filtering, discharge, backwash and start again. If less than 1/4" of cake has been deposited, the cake will not discharge well.

Too much body feed

In this condition, there is a chance of completely filling the space between the plates, yet not reaching terminal pressure drop. Damage to the plates may occur.

Both conditions should be avoided.

Fortunately, the system can be designed to minimize the chance of failure. The following design facts and assumptions have been made:

- 1) The amount of dry gelatin is 5% and completely dissolved.
- 2) With level control on the gelatin tank, the average feed rate will be controlled at 33 GPM.
- 3) The amount of turbidity is 1000 PPM.
- 4) BF to solids ratio 2:1.
- 5) The estimated cake density is 32 #/Ft³.
- 6) The cake capacity of the filter is 16 Ft³.

SAMPLE CALCULATIONS

A. Solids Input

$$W = QX_c(R + 1)$$

Where,

W = Rate of dry solids put in filter (including body feed)	$\frac{(\#BF + \#Waste\ Solids)}{HR}$
Q = Filtration Rate	$(\#Slurry/HR)$
X_c = Waste solids concentration	$(\#Waste\ Solids/\#Slurry)$
R = Body to solids ratio	$\frac{(\#BF)}{(\#Waste\ Solids)}$

So,

$$W = 33GPM \times \frac{500\#}{HR/GPM} \times .001 \frac{\#Waste\ Solids}{\#Slurry} \times 3 \frac{\#Total\ Solids}{\#Waste\ Solids}$$
$$W = 49.5 \#/Hr$$

B. Cycle Time

$$t = \frac{V_f d}{W}$$

Where,

t = Time required to fill cake capacity of filter	(HR)
d = Cake density	$(\#/Ft^3)$
V_f = Cake capacity of filter	(Ft^3)

So,

$$t = \frac{(16\ Ft^3)(32\ \frac{\#}{Ft^3})}{49.5\ \#/Hr}$$

$$t = 10.3\ \text{hours}$$

C. Estimated Rate of Body Feed Required

$$\overline{BF} = QX_cP$$

Where,

$\overline{BF}$ = the rate of dry body feed addition	$\frac{(\#BF)}{(HR)}$
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$$\overline{BF} = 33\ GPM \times 500\ \frac{\#}{HR \cdot GPM} \times .001 \frac{\#Waste\ solid}{\#Slurry} \times 2 \frac{\#BF}{\#Waste\ Solids}$$
$$\overline{BF} = 33\ \#/Hr$$

D. Estimated Total Amount of Body Feed

$$BF = \overline{BF} t = QX_cRt$$

$$BF = 33\ \frac{\#}{HR} \times 10.3\ Hr = 339.9\ \#$$

Use 350# Procedure: Mix 350 # of Body in 500 gallons of H₂O

E. Body Feed Tank Concentration

$$X_{BF} = \frac{BF}{4170 + BF}$$

Where, X_{BF} = Concentration of Body Feed ($\frac{\#BF}{\#BF + \#H_2O}$)

$$4170 = 500 \text{ Gallons} \times 8.34 \frac{\#}{\text{gal.}}$$

$$X_{BF} = \frac{350}{4170 + 350} = .0774 = 7.74\%$$

F. Body Feed Rate

$$\dot{BF} = \frac{\dot{BF}}{X_{BF}}$$

Where, $\dot{BF}$ = Rate addition of Body Feed Slurry ($\frac{\#BF + \#H_2O}{HR}$)

$$\dot{BF} = 33 \frac{\#BF}{HR} \times \frac{1}{.0774} \times \frac{\#BF + \#H_2O}{\#BF}$$

$$\dot{BF} = 426 \frac{\#BF + H_2O}{HR}$$

12. FILTERING

NOTE: The filter to be used should have been precoated and waiting full of water. The body feed slurry should have been made, and there is sufficient level in gelatin tank to allow for recycle for ten (10) minutes.

- 1) For Filter F-201A open valves AV-14, AV-5, and AV-7; (For F-201B open valves AV-19, AV-27, and AV-7) start P-3, P-202 and AG-1 (if not already running); put LIC-1 in manual at a position where PI-4 reads approximately 80 psig. Allow system to recycle until filtrate is clear. Take sample at gelatin tank to varify clarity. You are now ready to filter.
- 2) Set LIC to the approximate level of the gelatin in the tank. Put LIC in auto. Open AV-4 (AV-26 for F-201B) close AV-5, (or AV-27 for F-201B).
- 3) With the body feed concentration at 350# body feed per 500 gallon of water and body feed pump set at 426 #/Hr the body feed tank should empty in approximately ten (10) hours.

NOTE: This should keep the pressure to a rate of increase of 8 psig/hour (see Fig. 3). If the pressure increases at a faster rate, increase the speed of the body feed pump proportionally. If the rate of pressure increase is less than 8 psig/hour, decrease the speed of the body feed proportionally. If the amount of solids is greater than the

Body feed
#3 DE
✓31
✓41
✓37
✓35

NOTE: anticipated 1000 ppm, the pressure will rise rapidly, especially if the feed rate to the gelatin tank is faster than 33 gpm and the control valve is allowing P-3 to pump at a higher rate. If this happens, we must recalculate a cycle time and reset the body feed system.

13. SWITCHING FROM F-201A to F-201B

NOTE: 1. F-201B has been previously precoated (as described in Section B) and is waiting full of water.
2. Body feed slurry has been remixed.
3. Gelatin tank has capacity for 10 minutes recycle.

- A. Stop P-3, P-202; close AV-7, AV-4 and AV-14.
- B. Open AV-19 and AV-27.
- C. Start P-3; open AV-7; start P-202.
- D. Put LIC in Manual at position where PI-4 reads approximately 80.
- E. Recycle until clear; proceed as per instructions in Section E.

14. BLOW DOWN

NOTE: 1. Gelatin tank must have capacity for contents of filter.
2. Other Filter Must Not Be In Recycle.

- A. Open AV-11 and AV-12 (AV-24 & AV-20 for F-201B) for filter F-201A.
- B. Allow unit to blow down until air is noticed returning to gelatin tank. (estimated time 5-10 minutes)
- C. Close AV-11 and AV-12 (or AV-24 and AV-20).

15. DISCHARGE

- A. For F-201A open AV-28, AV-10 (AV-20 and AV-21 for F-201B); start F-201A motor (or F-201B motor), run for 20 seconds then stop, wait 10 seconds, run for 20 seconds, stop then wait for 10 seconds, run for 20 seconds, stop.

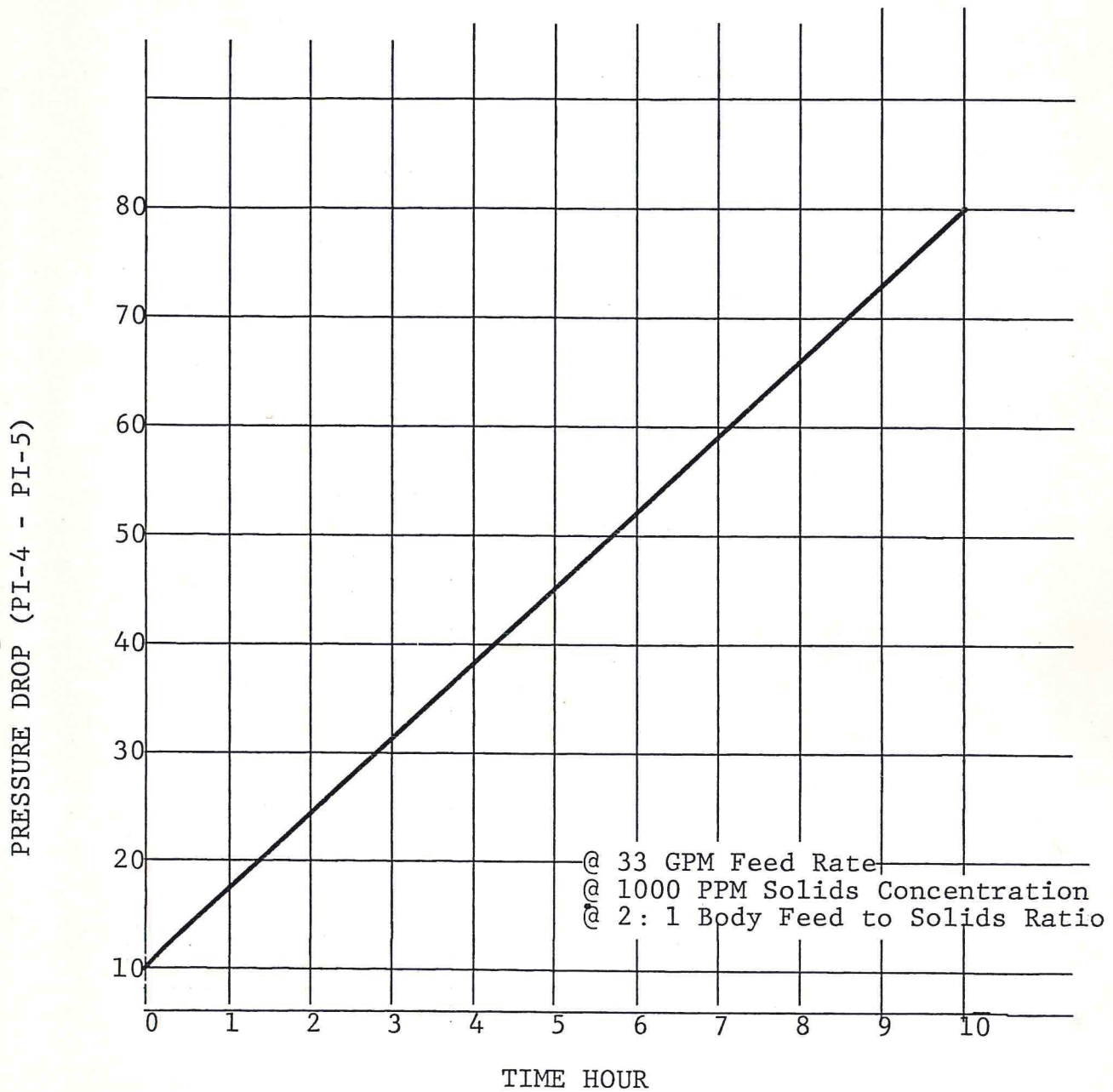
*16. BACKWASH

(CAUTION: DO NOT EXCEED 8 PSI backwash pressure on this step. DO NOT BACKWASH unless discharge valve is open.)

- A. For F-201A open AV-28, AV-10, AV-8, AV-9, (AV-29, AV-21, AV-8 and AV-22 for F-201B); adjust REG-1 until PI-5 (PI-7 for F-201B) shows 8 psig or less. Wait 1 minute or until you are sure water is at the top of the stack.
- B. Close AV-8; spin for 20 seconds, stop and allow to coast to a stop before opening AV-8 again.
- C. Repeat Step A.
- D. Repeat Step B.
- E. Repeat Step A.
- F. Close AV-8, AV-9 and AV-28 (AV-8, AV-29 and AV-22 for F-201B) close AV-10 only after shaft has been at a complete stop for a few seconds or so.

FIGURE 2

ESTIMATED OPERATING CURVE



NOTE: AFTER BACKWASHING, THE FILTER IS NOW READY FOR PRECOATING AGAIN TO PREPARE FOR THE NEXT FILTRATION RUN.

17. MAINTENANCE AND SERVICE

Before undertaking any major servicing, please be sure you have replacement parts, such as seals, available on site.

For servicing all parts such as gearboxes, hydraulic couplings, please consult separate Manuals provided.

Filters have prelubricated bearings, which need periodic lubrication.

At regular intervals check the seal flushing line test valve. If liquid shows when opening this valve under normal filtration pressure conditions, then one of the seals is faulty. Check that no excessive back-pressures have occurred in the filtrate line.

A tell-tale drilling is also provided in the upper bearing housing. Check that no liquid issues from this under normal pressure conditions. If it does, then the lip seals for this part of the housing are suspect.

We recommend that the filter leaves be removed for inspection once a year, in accordance with normal shut-down procedure.

This is normally a simple operation. Remove lid and withdraw the complete stack by lifting out the shaft. Use a proper hoist and make sure the lift is always vertical. If there are any signs of damage or wear in any of the screens, strip the stack down and

examine each plate, if necessary removing the screen from the plate and looking through it against a strong light.

If plates are removed, be sure that they are replaced exactly as under "Assembly" - Paragraph 4 - and that new gaskets are always used.

Check that foundation securing bolts are always tight, also all bolts securing drive units to base frame, etc.

Finally occasionally remove pressure gauges to check that they are not obstructed by accumulated solid. The same applies to safety valves. This may be decided by deliberate over-pressurizing and noting the pressure at which it blows.

Chemetron Service Engineers are at your disposal; if in any doubt, please consult us.