KROFTA

KROFTA SUPRACELL

OPERATION AND MAINTENANCE MANUAL

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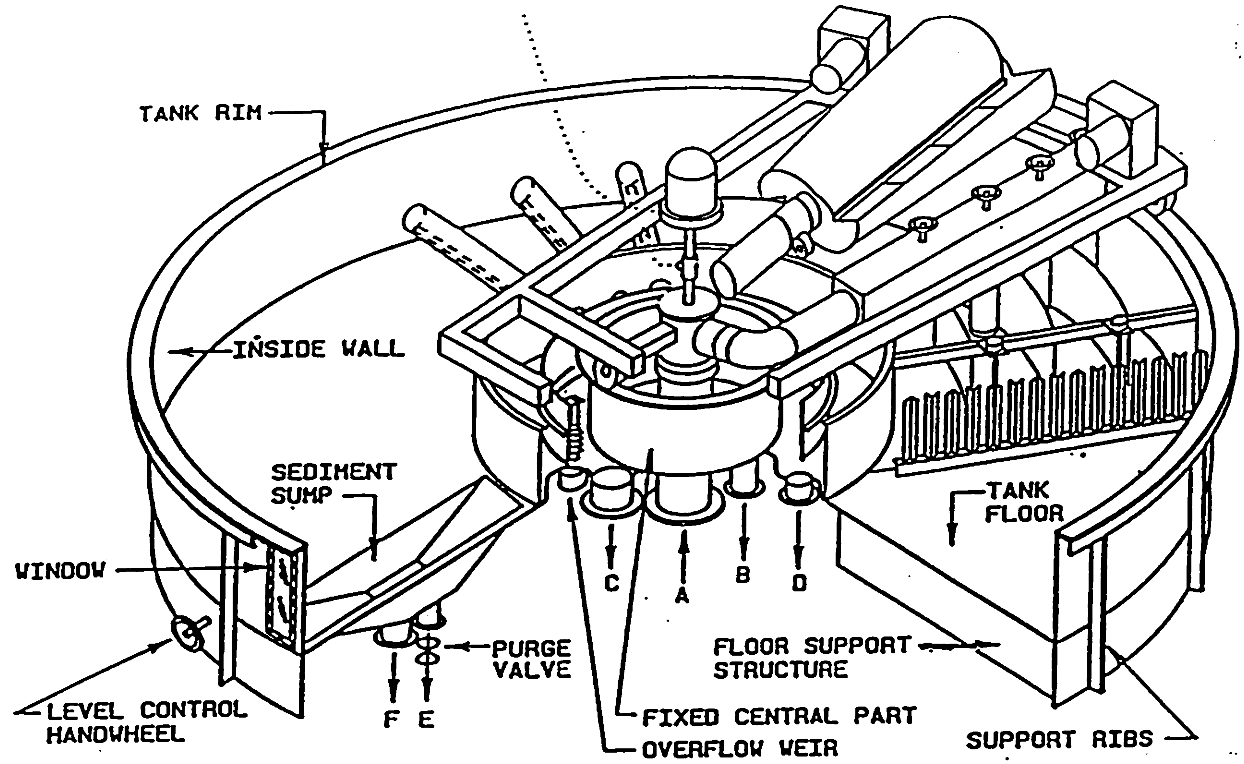
1) THE KROFTA SUPRACELL 'ZERO VELOCITY' PRINCIPLE OF OPERATION

The **KROFTA SUPRACELL** removes solids by means of air flotation and sedimentation. Turbulence caused by water movement is a very important factor in flotation and greatly reduces the efficiency of other types of flotation units. In conventional, stationary units, there must always be water movement in order for the water to flow from inlet to outlet. With the **SUPRACELL**, the inlet and outlet are not stationary but are rotating about the center. The rotation is synchronized so that the water in the tank achieves **'ZERO VELOCITY'** during flotation. This means that the efficiency of the flotation is greatly increased to near the maximum theoretical limits. In practical terms, this allows better clarification in smaller surface areas and in a much shallower tank. The open tank has an approximate depth of 18 inches. Water is processed from inlet to outlet in two to three minutes.

2) *KROFTA SUPRACELL - SAFETY REQUIREMENTS*

KROFTA SUPRACELL units are equipped with equipment safety guards for operator protection from outside the unit. **SUPRACELL** units size **SPC 27** and larger are equipped with walkways allowing limited operator access onto the **SPC** unit. For operator access to the **SUPRACELL** walkway, wait until the walkway is in the best access position before stopping both the Carriage and Spiral Scoop gearmotor. At no time should any adjustment, inspection, or maintenance be undertaken on or in the **SUPRACELL** unit without the entire unit being completely shut down with the main power switch to the electrical equipment shut off. It is required that a lock be put on the main power switch in the "off" position at times when personnel are working on or in the **SUPRACELL** unit. The manufacturer **(KROFTA ENGINEERING CORPORATION)** will not accept any responsibility for claims resulting from injuries caused by failure to follow the above guidelines.



PIPE CONNECTIONS

A - UNCLARIFIED WATER INLET	D - RECYCLE OUTLET
B - FLOATED SLUDGE OUTLET	E - PURGE
C - CLARIFIED WATER OUTLET	F - DRAIN

4) SUPRACELL GENERAL DESCRIPTION

TANK COMPONENTS (Non-Rotating Parts)

SUPRACELL wetted tank parts, inside wall, and floor are standard in stainless steel. Non-wetted parts tank rim, outer support ribs, and floor support structure are standard in epoxy painted mild steel. Customer pipe connections are at flanges located under the unit as shown. A sump well in the tank floor is provided to collect sediment pushed in by a rotating bottom scraper. A purge valve is standard with automatic controls for timed sediment removal. A window located on the tank wall is adjacent to the sump for visual verification of floated sludge thickness and sediment buildup. The outer tank rim supports the rotating carriage drive and support wheel. The Fixed Central Part, standard in stainless steel, supports the inner support and centering wheels and receives floated sludge drained from the Spiral Scoop. Options include concrete floor and outer tank wall, or all mild steel units, epoxy painted.

LEVEL CONTROL

Standard steel **SUPRACELL** units have a circular Overflow Weir which surrounds the Fixed Central Part tank. Its height is adjustable and is handwheel controlled. It maintains a precise water level in the unit which is critical for controlling the scooping depth and therefore the sludge removal rate of the Spiral Scoop. An alternate level control method utilizes a float or differential pressure type level sensor controlling an automatic valve.

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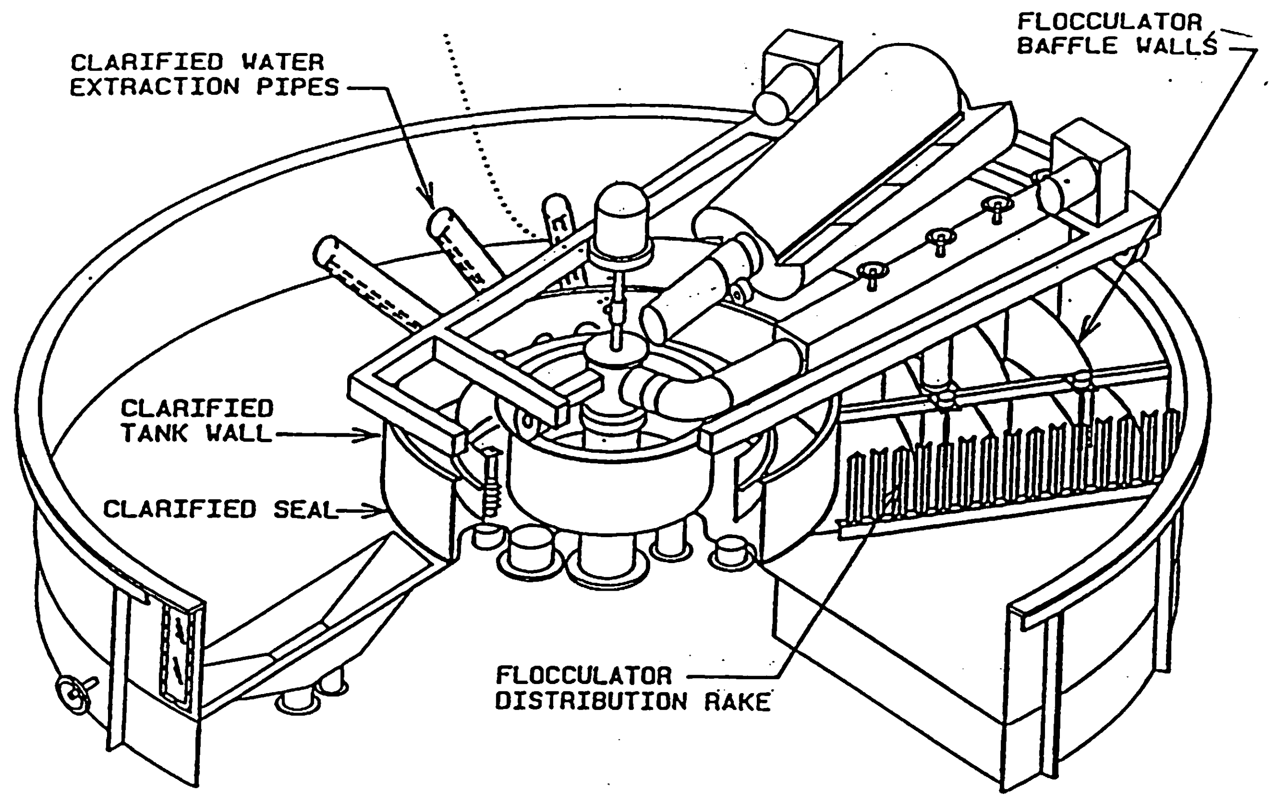

4) SUPRACELL GENERAL DESCRIPTION (Cont.)

ROTATING TANK COMPONENTS (Movable Part)

Clarified water is drawn off several inches above the floor of the main tank through slots in the Extraction pipes. They draw the clarified water into the clearwell area within the Clarified Tank Wall. Because the entire assembly rotates, the Clarified Tank Wall has a skirt type neoprene seal to seal against the tank floor which separates the clarified from the unclarified water.

Other components of the Movable Part are the Flocculator Channels, the back-splash for the Spiral Scoop, and the structure supporting the Inlet Distribution Tube. A neoprene bottom wiper under the spiral scoop back-splash scrapes sediment into the sediment sump. A neoprene tank side scraper adjacent to the scoop cleans sludge from the tank wall.

The Flocculator Distribution Rake has a height adjustment mechanism operated by handwheel, lever, or wingnut depending on the unit size. Rake adjustment criteria is to allow minimum water flow over the top while still allowing sludge overflow. Too high an adjustment can dam up sludge behind the Rake, causing an inconsistent sludge blanket and possible sludge overflow onto the rim.

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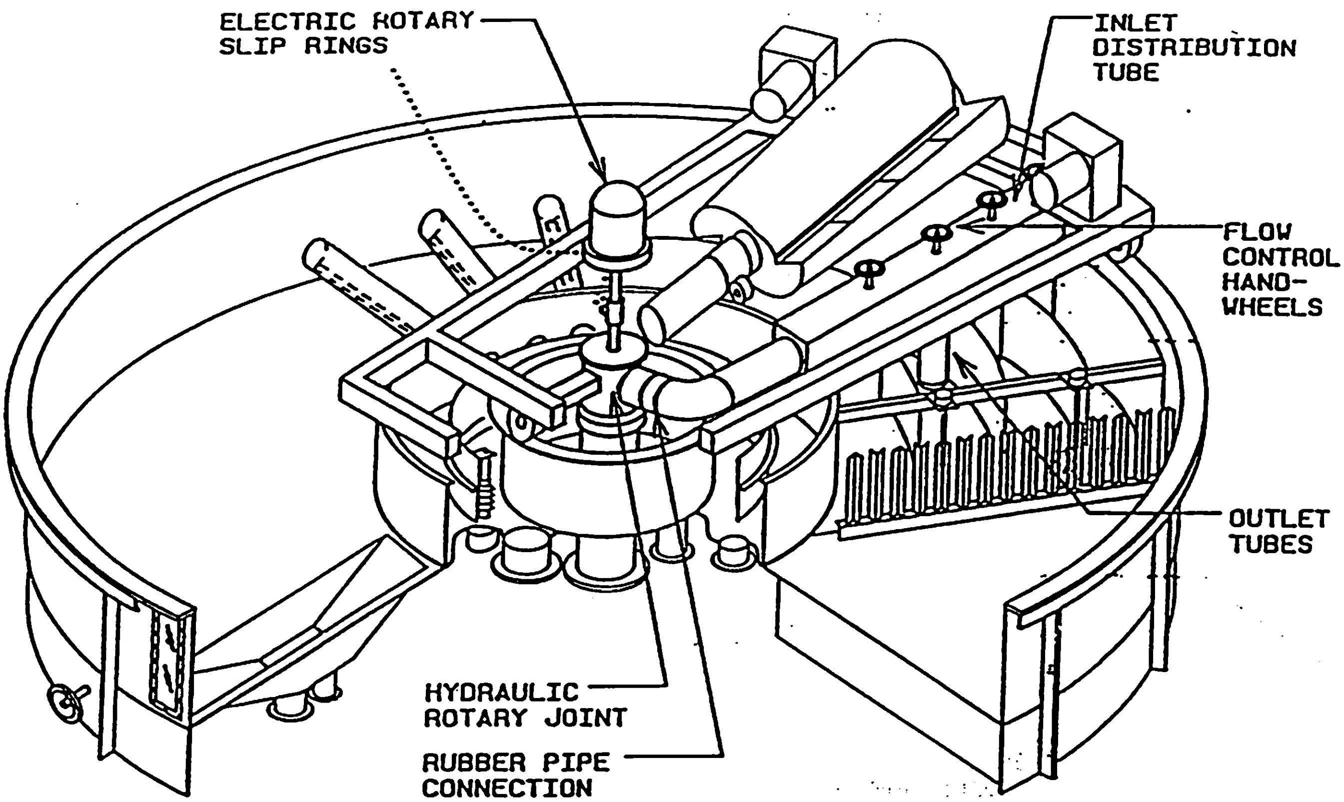


4) SUPRACELL GENERAL DESCRIPTION (Cont.)

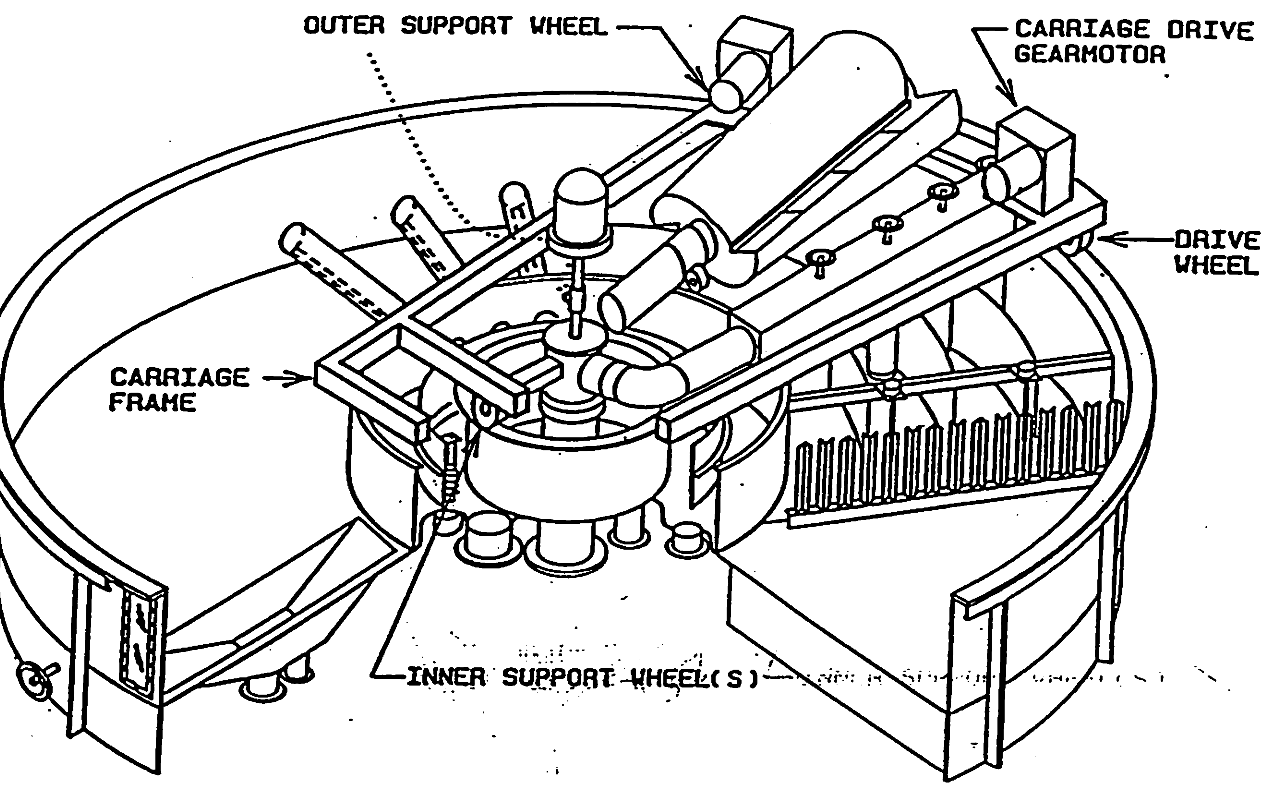
CARRIAGE FRAME (Movable Part Support)

The Carriage Frame rotates the Movable Central Part, the Inlet Distribution Tube Header, the Spiral Scoop, and other parts around the tank. The Carriage is supported by the Drive Wheel, Movable Part Outer Support Wheel(s), and the Movable Part Inner Support Wheel(s).

The Drive Wheel has a polyurethane tire with a conical taper and is mounted at an inward tilted angle to minimize rotating resistance and subsequent wear as it rotates around the outer tank rim. The Drive Wheel Shaft is supported at each end by pillow block or flange bearings. A chain and sprocket drive system connects the Drive Wheel with the Carriage Drive Gearmotor.

The support wheels typically have internal bearings and are supported on a vertical, rigid frame. Wheel material is steel, bronze, polyurethane or UHMWP, crowned or beveled for lower rolling resistance. Small **SUPRACELL** units are provided with self-lubricating UHMWP material wheels without bearings.

Chainguards enclose chain drives for operator safety.

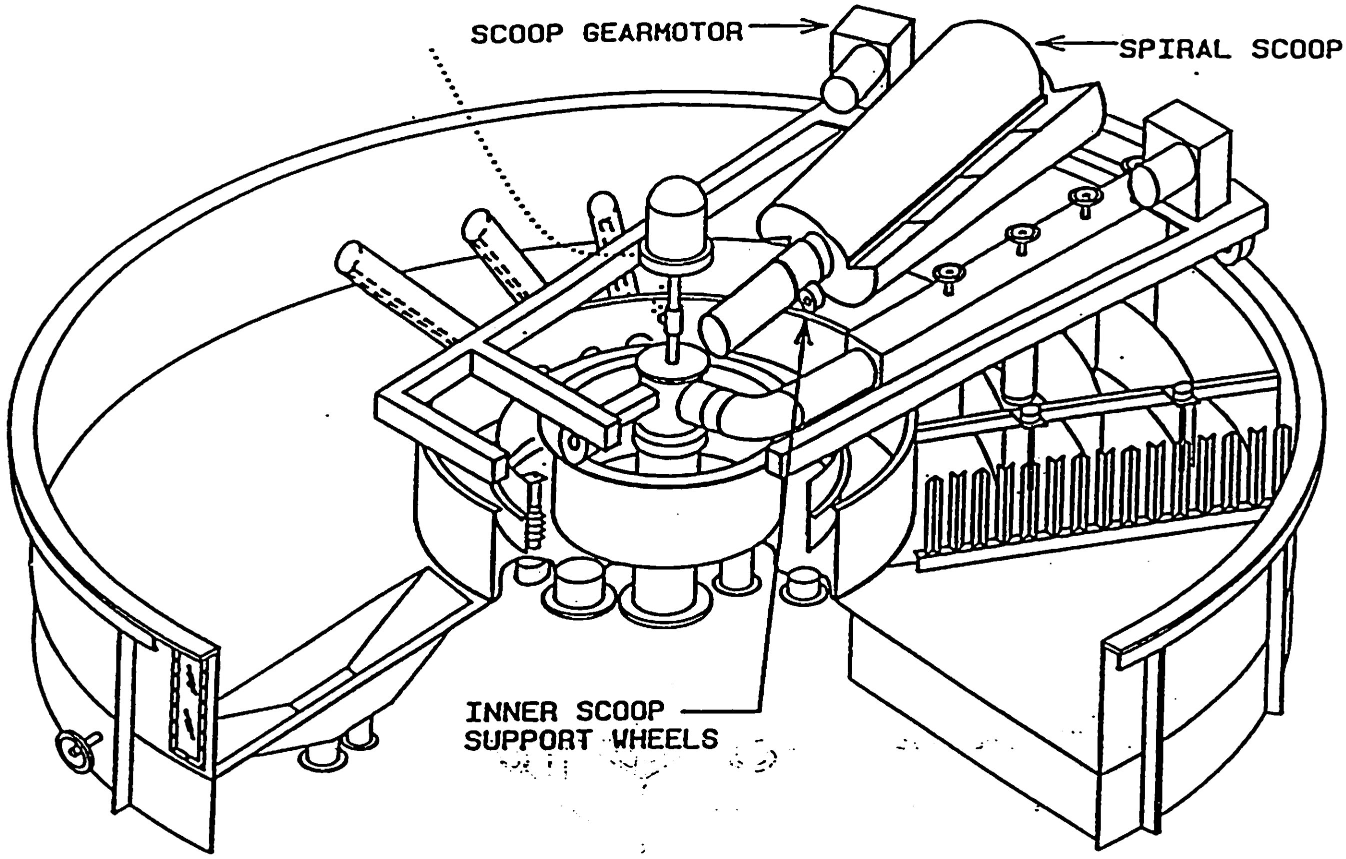


4) SUPRACELL GENERAL DESCRIPTION (Cont.)

SPIRAL SCOOP

The **KROFTA** Spiral Scoop, standard in stainless steel, removes floated material from the top surface of the water for discharge into the Fixed Central Part Tank for removal from the unit. It is supported on the outer end by a bearing that is mounted to the Carriage Frame. The inner end of the Scoop is supported by two inner support wheels which are similar in construction to the Carriage Support Wheels. Some small **SUPRACELL** units use a bearing or saddle type plastic bearing as the inner scoop support method.

The Spiral Scoop is driven by a gearmotor connected to the Scoop's outer end by a sprocket and chain drive system. Primary control of the Spiral Scoop sludge removal rate is by water level adjustment, as explained in the Level Control section. For fine adjustment of scoop removal rate, the speed of the Scoop rotation can be adjusted by use of the externally mounted variable speed motor controller.



4) SUPRACELL GENERAL DESCRIPTION (Cont.)

ROTARY JOINT AND INLET DISTRIBUTION TUBE

The Rotary Joint allows raw inlet water to enter the rotating Inlet Distribution Tube for rotary distribution into the **SUPRACELL** tank. The Rubber Pipe Connection provides a flexible connection between the two components. The Inlet Distribution Tube serves as a header box for a number of smaller outlet tubes which feed into the channels formed by the flocculation baffle walls. The outlet tubes are spaced to provide the correct distribution of water into the tank. Handwheels on top of the Distribution Tube vary the distance of valve disc plates from the end of the outlet tubes. By rotating clockwise (screwed downward) the tubes are opened. Balancing the flow rate across the Distribution Tube is important to minimize turbulence at the flocculator outlet.

For initial flow adjustment, before start-up, fully close all valves before opening each exactly 15 turns. After start-up, adjust all valves an equal number of turns until flow appears even. Avoid too small a valve opening which can pressurize and damage the Distribution Tube during operation.

5) SUPRACELL OPERATION AND TROUBLESHOOTING PROCEDURES

A. INITIAL START-UP PROCEDURES

1. Close all drain, sampling, automatic bottom purge and air inlet valves to the **KROFTA SUPRACELL** and AIR DISSOLVING TUBE.

2. Open all Inlet Distribution Tube outlet handwheels exactly 15 turns clockwise adjusted from their fully closed position.

3. Start the drive motors for the carriage and scoop. Adjust the drive speed so that the **SUPRACELL** carriage revolves approximately once every three minutes.

4. Turn on the **AIR DISSOLVING TUBE**, the recycle pressure pump and the air compressor. Adjust the air pressure regulator to 90 - 100 PSIG. Adjust the air flow meter valves until the flow reading is about 1/2 scale or approximately 30 SCFH. Note that the air pressure must always be higher than water pressure to prevent backing of water into the air lines.

5. Start the chemical flocculent pumps.

6. Turn on the raw water feed pump, or open the inlet valve if gravity fed.

7. Set the level control so that the Scoop is removing surface sludge.

B. ADJUSTMENT PROCEDURES DURING OPERATION

1. See **AIR DISSOLVING TUBE** operation instructions for flow and performance adjustments.

2. Adjust the Inlet Distribution Tube outlet handwheels an equal number of turns each until flow into the **SUPRACELL** appears even. It is important to close the valves enough to create about six inches of water "head" in the Distribution Tube necessary for even flow from the outlet tubes. Avoid too small a valve opening which can pressurize and damage the Distribution Tube during operation. Attempts to balance the flow by unequal valve openings should be avoided if possible.

B. ADJUSTMENT PROCEDURES DURING OPERATION (Cont.)

3. The exact speed setting of the carriage drive motor should be calculated or set by observing the water in the tank. The water in the tank must have 'Zero Velocity.' In other words, the speed at which the water enters the unit should equal the speed at which it is discharged. This will yield the least amount of turbulence in the flotation tank. A change in flow rate will require adjustment of rotation speed. To calculate, add the raw flow to the recycle flow to establish total GPM flow into the unit. Calculate the volume of the **SUPRACELL** flotation zone in gallons. The time the carriage takes to make one tank revolution should equal the retention time of water in the unit. For example, 300 GPM flow into a **SUPRACELL** with a volume of 900 gallons has a retention time of three minutes. Therefore, the carriage should be adjusted to revolve once every three minutes.

4. The water level in the **SUPRACELL** should be adjusted for optimum floated sludge collection by the Spiral Scoop. Lowering the water level reduces sludge collection, allowing a thicker, dryer layer of sludge to form on the surface. Raising the level increases collection and thins out the sludge layer. It will take up to an hour after a level change before the sludge thickness reaches equilibrium. The sludge layer becomes too thick when it begins to break up in pieces and/or settle out.

   Adjustment of the Spiral Scoop rotation speed is important for fine tuning the sludge removal rate after the water level is established.

5. The settled sludge purge should be set depending on how much and at what rate settled material collects in the system. Typical purge valve time open duration would be 5 to 10 seconds or until clear water flows out. The interval between valve openings should initially be set between 15 minutes to one hour and then adjusted based on operating experience.

C. SHUT-DOWN PROCEDURES

1. Turn off the chemical pumps.

2. Turn off the AIR DISSOLVING TUBE pressure pump before closing the isolation valve from the compressor.

3. Turn off the power to the Purge Valve Timer (if equipped) leaving air pressure on to maintain valve in closed position if water is to remain in the **SUPRACELL**.

C. SHUT-DOWN PROCEDURES (Cont.)

4. Continue to operate the Spiral Scoop and Carriage drive until remaining sludge has been removed. Clean-up is easier if the **SUPRACELL** is allowed to run after the process flow has stopped. Clarified water will recirculate and most of the solids will be flushed from the system.

5. Valve and control settings previously established should not be changed.

6. The water does not have to be drained out unless the shut-down is for a long period or complete wash-up is necessary.

7. If the **SUPRACELL** is drained, hose down all parts thoroughly; dried-on sludge can be very difficult to remove.

D. NORMAL START-UP AND OPERATION PROCEDURES

1. Follow the same sequence as for initial start-up, except that previously established valve and control settings should be maintained and unchanged.

2. Check that the **AIR DISSOLVING TUBE** pressure is 60 - 80 PSI and that the clarified water is clear. If not, follow the procedure in Part E (Trouble Shooting Procedures).

3. If the **SUPRACELL** is started up before process start-up, the **SUPRACELL** will operate and continuously recirculate and clean the clarified water. This will help prevent solids build-up in the clarified water during start-ups.

E. TROUBLE SHOOTING PROCEDURES

Poor water clarification in the **SUPRACELL** can be a result of problems caused by solids overloading, poor flotation resulting from **AIR DISSOLVING TUBE** problems, or inadequate/improper chemical addition. A water sample taken from the inlet area of the **SUPRACELL**, preferably in a graduated cylinder, provides many clues for diagnosing problems.

E. TROUBLE SHOOTING PROCEDURES (Cont.)

The following are some common areas to check if there are clarification problems:

1. SOLIDS OVERLOADING PROBLEMS

Overloading is a result of unusually heavy solids loads on the **SUPRACELL**, as can occur at washups or at times of heavy solids loading from the process. Overloading can cause unclear water and in extreme cases physically clog parts of the system. The most effective solution is to simply decrease the solids loading if at all possible. If the overload clogs the system with sludge, the system will unclog itself when the overload stops, unless the thick sludge is allowed to block the clarified water pipes. Overloads can sometimes be compensated for by adding more chemical. **NOTE: Do not run the SUPRACELL when it is completely filled with heavy sludge.** This can cause strain and possibly damage rotating parts.

2. CHEMICAL ADDITION PROBLEMS

NOTE: Chemical addition should not require day-to-day adjustments.

a. Not enough chemical. Symptoms include very small particles remaining in the clarified water, slow flotation, or thin floated sludge, Check the following items:

* Chemical pump or lines plugged?
* Out of chemical?
* Have pump settings been changed?
* If the concentration of solids in the incoming water has changed or there is some change in the pH, defoamer addition, etc., this may change the chemical demand requiring higher amounts.

b. Too much chemical. Symptoms of chemical overdosing include a very "greasy" sludge, a watery or "flat" sludge, and very large particles in the water to which the air will not stick. This could also indicate the presence of defoamer in the system. A slippery or greasy feel in the clarified water can also indicate overdosing resulting in chemical carry-over into the clarified water.

NOTE: All chemical adjustment should be made slowly, as changes can take from 3 to 20 minutes to take full effect. If the clean water is recycled, changes can take hours to be fully observed.

E. TROUBLE SHOOTING PROCEDURES (Cont.)

3. AERATED RECYCLE WATER ADDITION PROBLEMS

NOTE: See also **AIR DISSOLVING TUBE SYSTEM** for additional information.

a. Too much "air" in system. This is indicated by foaming or frothing at the **SUPRACELL** water surface, excessive and large turbulent bubbles at the inlet, and by foamy sludge. Before changing settings, check the following:

* Dissolving tube air bleed-off plugged? (This can cause large bubbles in the inlet).
* Had air addition to the **AIR DISSOLVING TUBE** changed?
* Is the feed pump pulling in air or cavitating?
* Has detergent, caustic, or other foaming agent been added to the water?
* Solids in the feed water unusually low?

b. Not enough "air" in system. This is indicated by watery sludge, sludge not floating or floating slowly, and by a very "flat" appearance of the inlet water.

* Is air line plugged or has air pressure dropped lower than pressure in **AIR DISSOLVING TUBE?**
* Is air pressure reduced, causing reduced air flow?
* Check for chemical problems such as defoamer in system, chemical overdose.
* Very reduced water flow caused by a plugged valve or cavitating of the feed pump may greatly reduce dissolving efficiency.
* Unusually high solids in the incoming water may also cause the above symptoms. This can sometimes be corrected by increasing air addition.

F. TROUBLE SHOOTING PROCEDURES - MECHANICAL

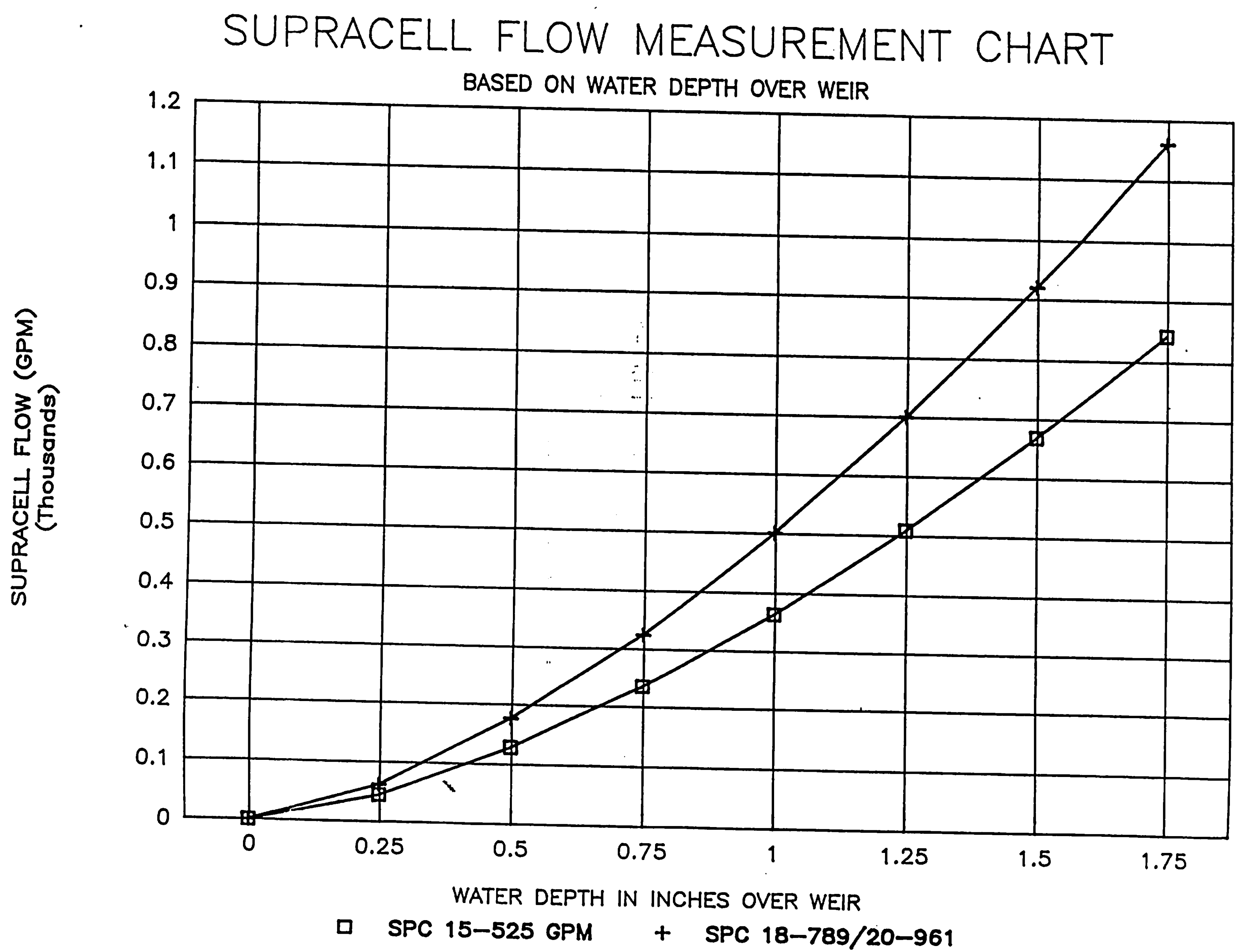
1. DRIVE WHEEL SLIPPING

Spinning or stalling of the Drive Wheel is usually a symptom of other problems in the system. The friction drive is a torque overload control. If there is a heavy load on the system, the wheel should slip before any serious mechanical damage is done. Typical causes of slipping are:

* Check if the drive wheel is worn down or damaged. If so, that usually indicates the presence of other problems mentioned. (Normal tire life is 1 -2 years).

F. TROUBLE SHOOTING PROCEDURES - MECHANICAL (Cont.)

* Proper wheel alignment of the Drive Wheel and support wheels is important for wheel life and to reduce resistance.
* Excessive loads of solids in the Clarifier. If the Clarifier is allowed to fill with floated sludge, the force required to move the rotating parts is much higher. The overload condition should be fixed by draining the sludge out and starting over again if possible, or by raising the level and speeding up the Scoop. If the sludge is very thick, water dilution may be necessary at first. This kind of condition should be corrected as soon as possible to avoid damage of the rotating parts.
* Excessive settled sludge in the Clarifier. This usually is the result of non-function of the bottom purge or of some upset in the Clarifier which has caused excessive settling. The bottom purge should be operated frequently until the condition is cleared. A sample scraped from the bottom of the unit or taken from the bottom purge line can help identify this problem.
* Foam or polymer on edge. Excessive foaming can result from chemical problems in the process or improper air addition. Foam can carry a high load of flocculent polymer which is very slippery. This should be thoroughly washed off.
* Mechanical malfunction. The general cleanliness of the unit and the function of the wheels, especially the centering wheels, should be checked thoroughly. The unit should be emptied and cleaned thoroughly and operated empty with all mechanical clearances (especially on the outside edge) checked.


SUPRACELL FLOW MEASUREMENT CHART
BASED ON WATER DEPTH OVER WEIR
SUPRACELL FLOW (GPM)
(Thousands)
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.25
0.5
0.75
1
1.25
1.5
1.75
WATER DEPTH IN INCHES OVER WEIR
SPC 15–525 GPM
SPC 18–789/20–961

6) KROFTA AIR DISSOLVING TUBE SYSTEM

A. GENERAL PRINCIPLES

The **KROFTA** Flotation System removes solid impurities from the water by floating them to the surface. The reason that the impurities will float, even when they are heavier than water, is that microscopic air bubbles attach themselves to the impurities, or flocks, and make them buoyant.

B. OPERATIONAL DESCRIPTION

The process for forming the air bubbles is as follows:

1. Water pressurized to 70 - 80 PSI enters the **AIR DISSOLVING TUBE** (ADT) through the inlet. The water enters tangentially and spirals through the length of the tube. See Drawing U4-DT-205 and U4-DT-209.

2. Compressed air is injected through special air dispersion panels, Item 4.

3. The water and air are mixed rapidly within the tube for 10 seconds before exiting the tube outlet. Any undissolved air accumulates in the center and is separated out by the bleed-off line in the center of the tube.

4. The pressure is released into the clarifier. When the pressure is released, the water can no longer hold the dissolved air in solution. This causes microscopic air bubbles to spontaneously form throughout the liquid. If clear water is used, it will take on a milky white appearance. This can be seen by taking a sample of the mixture in a clear container. This rise rate of the proper sized air bubbles should be no faster than approximately 8 - 12 inches per minute. (For proper operation, the bubbles formed should be smaller than the particles, or flocculated material they are removing).

C. ADT COMPONENT DESCRIPTION

1. AIR DISSOLVING TUBE

The tube, Item 1, Drawing U4-DT-205, is designed to retain water and air under pressure. The inlet nozzle, Item 3, increases the velocity of the water entering the tube and directs it tangentially, causing a spiraling motion. The pressure and swirling in the tube cause the air to become dissolved in the water. The ADT requires a minimum flow and pressure drop to work properly, similar to the operation of a centrifugal cleaner. The nozzle also provides a pressure drop, nominally 8 PSI at design flow, which is used to calculate the flow rate.

6) KROFTA AIR DISSOLVING TUBE SYSTEM (Cont.)

Any undesirable, large undissolved air bubbles tend to collect along the central axis of the ADT. This air is continually removed to prevent the tank from filling with air.

2. *AIR METER*

The amount of air needed by the ADT depends on the water flow through the unit and the amount required to properly float the solids. The amount added is a small percentage of the amount of water required. The air quantity is precisely metered by an Airmeter, Item 5.

The compressed air supplied to the ADT must be pressure regulated and filtered of any oil or moisture. Minimum gauge pressure should be 85 - 100 PSI or at least 5 PSI higher than the internal ADT pressure. The air meter needle valve(s) require adjustment for the proper air flow reading, initially set at 30 SCFH. The air enters the ADT into internal dispersion panels and is mixed and dissolved into the water.

3. *PRESSURE RELEASE VALVE(S)*

The pressure release valve is the point at which the small air bubbles necessary for flotation are formed. The pressure release valve also functions to control the flow and pressure through the ADT. (See attached pressurized water release system data).

4. *PRESSURE GAUGES*

A pressure gauge is provided at the ADT with one connection to the inlet piping before the entrance into the ADT and another connection to the main body of the ADT. Isolation valves are used to allow pressure readings from one connection at a time. The ADT contains a nozzle in the inlet connection which directs the water flow into a spiraling motion and which also causes a pressure drop. By noting the pressure difference between the two pressure gauge connection points, the rate of flow through the tube can be determined. At design flow, the pressure drop should be approximately 8 PSI. The minimum pressure drop should be at least 4 PSI or 70% of the rated flow. A drop over 10 PSI would indicate a higher than rated flow which may in turn decrease the efficiency of the ADT. An ADT Flow Measurement Chart is included in this manual showing specific flow readings for the particular ADT supplied.

An additional pressure gauge is provided near the pressure release valve to help monitor the system pressure when the valve is adjusted.

6) KROFTA AIR DISSOLVING TUBE SYSTEM (Cont.)

5. *SAMPLE VALVE*

The sampling valve is used to determine if the air dissolving system is operating properly. Samples are drawn off to observe the flotation characteristics before the air/water solution enters the clarifier. This sample point is an important tool for monitoring the ADT operation.

D. ADT ADJUSTMENTS

Under normal circumstances, no adjustment should be needed after the initial set up. If a problem should occur, make the following checks:

1. *TAKE A SAMPLE FROM THE SAMPLING POINT*

This is the best indication of the ADT operation. The sample should be drawn off into a graduated cylinder or other glass container. By looking closely, the air can be observed in the water. The air bubbles should be very small, giving the water a "milky" appearance. Larger bubbles should not be present. If enough air is present, the "flocks" should rise to the surface at a rate of one foot per minute, leaving clear water underneath. The ADT is functioning properly and requires no adjustment if this is what is observed.

If the sample shows large air bubbles and/or poor flotation, then check Items 3 and 4.

If there appears to be plenty of the proper size bubbles, but the "flocks" appear weak and the water underneath does not become clear, then check the chemical addition, Item 2 below.

If there is not enough air, then check Items 3 and 4 below.

2. *CHEMICAL ADDITION*

Check to be sure that the chemical pump is functioning properly. A clear piece of pipe in the chemical feed line is useful to allow a visual check of chemical addition into the clarifier.

Increasing the amount of chemical added will often improve the flotation. If chemical addition is increased, it should be accomplished in small increments with at least a 5 to 10 minute wait between increases to allow for stabilization of the process.

6) KROFTA AIR DISSOLVING TUBE SYSTEM (Cont.)

D) ADT ADJUSTMENTS (Cont.)

Generally, if the solid loading is increased to the clarifier, then the amount of chemicals needed should also be increased in proportion.

Overdosing with chemicals can sometimes cause "slippery" flocks which do not stick to the air and thus sink. This also causes the sludge to appear wet and "greasy" and it would be very slippery to the touch.

3. *THE BLEED-OFF SIGHT TUBE*

The Bleed-off Sight Tube, Item 10, is an integral component of the ADT. It controls the proper amount of bleed-off from the system and also provides a good indication of the air/water solution from the ADT.

If there is not enough air being added to the system, only water will discharge from the tube. First check the system to make sure that it is operating at proper pressure and flow. Increase air into the system in small quantities until proper air/water solution is discharged, or until flotation improves in the clarifier.

If air is only discharged form the bleed-off, reduce the air meter settings. Excess air may cause turbulence in the clarifier or excessive foaming.

4. *PRESSURE AND FLOW ADJUSTMENTS*

The pressure can be checked at three points in the system:

a. Air should be regulated at 80 - 90 PSI, Item 5, or at least 10 PSI higher than internal tube pressure.

b. The pressure gauge at the inlet connection is used for readings of water flow into the ADT and for pressure in the ADT. See Section C, Item 4, on Pressure Gauges.

c. Pressure gauge at the outlet monitors the system pressure when the pressure release valve is adjusted.

Always check the pressure gauges to be sure that the pressures have not changed. If B and C increases, this usually means the pressure release valve is plugging, the valve should be cleaned and reset to the correct pressure.

6) KROFTA AIR DISSOLVING TUBE SYSTEM (Cont.)

D) ADT ADJUSTMENTS (Cont.)

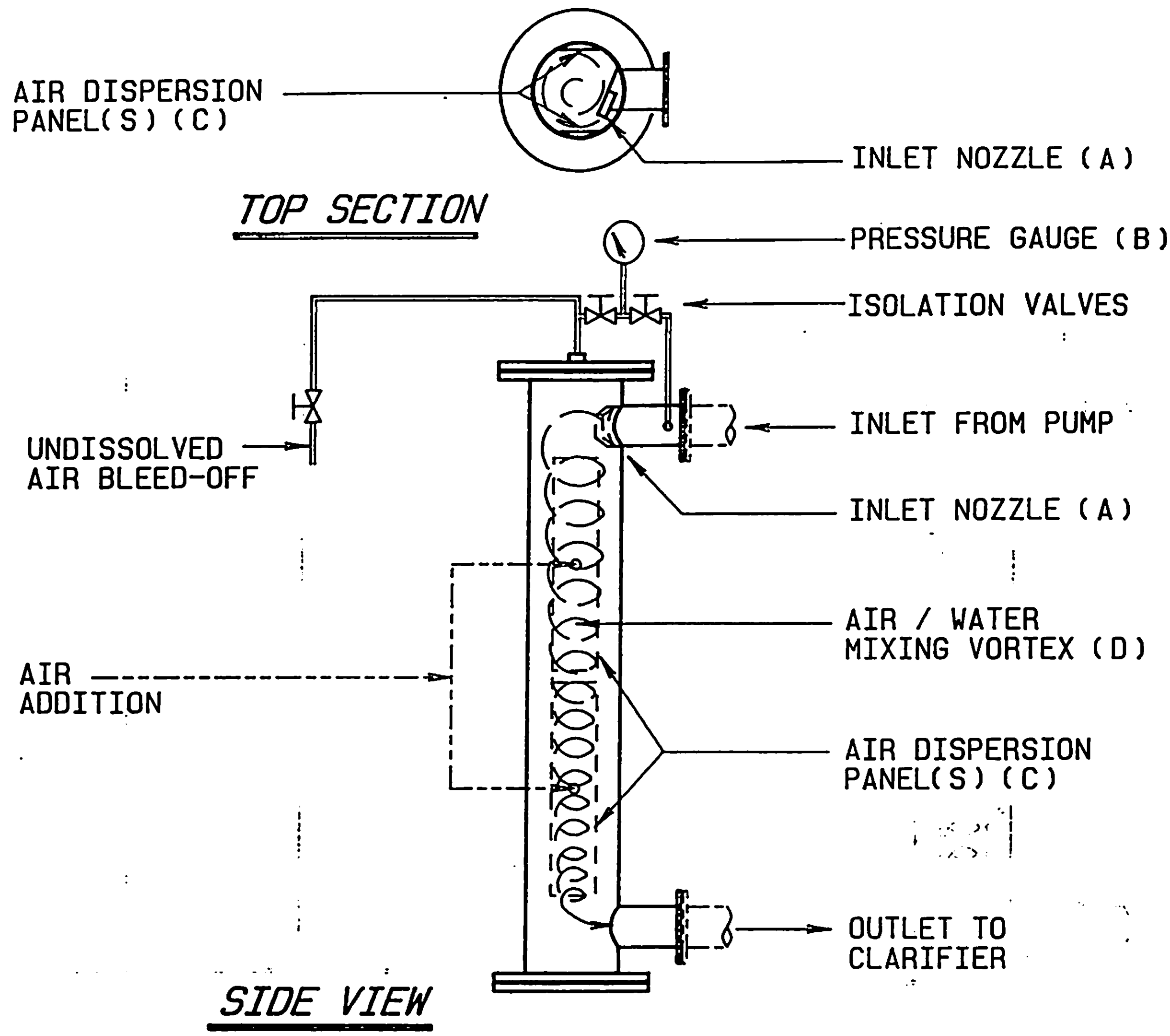
5. SHUT-DOWN AND START-UP PROCEDURES

For short-term shut-down, the pressure pump can be turned off no more than several minutes while the compressed air is left on.

For longer period shut-downs or for maintenance, the pump and compressed air should both be turned off. The water remaining in the ADT should be drained off. All connecting pipe lines should also be drained.

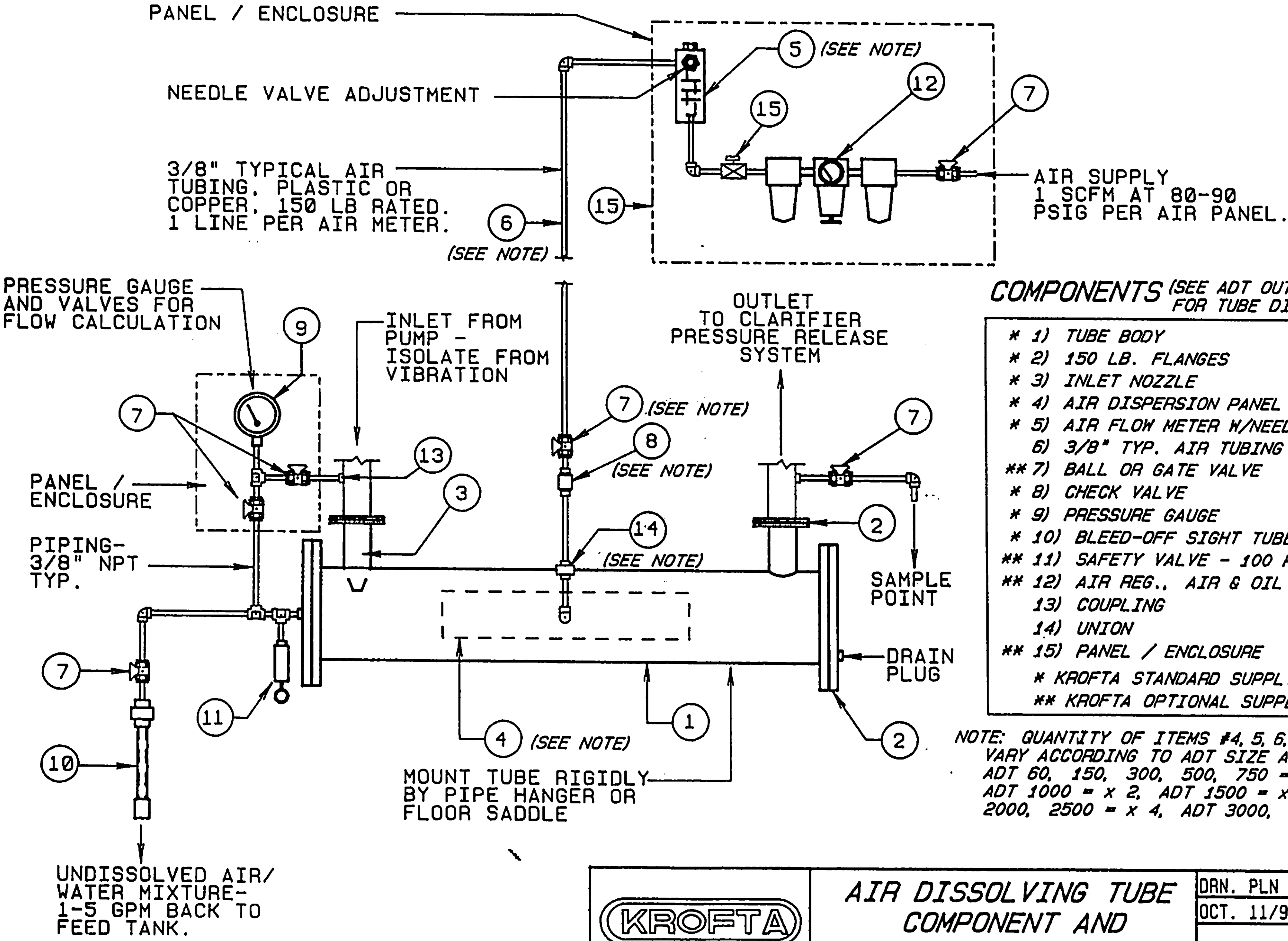
At start-up, close all drain valves, turn on the air compressor, and start the pump. The pressure gauges should be checked and a sample of the air/water solution should be taken after the system stabilizes.

NOTE: If more than 15 PSI is required to push air into the ADT, the dispersion panels have clogged form oil and other contaminants and must be replaced. Pressure drop on the panels should be checked monthly.



THE UNIQUE KROFTA AIR DISSOLVING TUBE (PATENT PENDING) IS A COMPACT DEVICE WHICH RAPIDLY MIXES AND DISSOLVES AIR INTO PRESSURIZED WATER. WATER ENTERS THE TUBE THROUGH AN INLET NOZZLE (A) WHICH INCREASES THE WATER VELOCITY WHILE DIRECTING IT TANGENTIALLY TO SPIRAL INSIDE THE TUBE. THE INLET NOZZLE SIZE IS CALIBRATED FOR THE REQUIRED FLOW ALLOWING FLOW RATE MEASUREMENT BY DIFFERENTIAL PRESSURE THROUGH THE TUBE USING A PRESSURE GAUGE (B). REPLACEABLE POROUS PLASTIC PANELS (C) THAT ARE INSTALLED INSIDE THE TUBE DISTRIBUTE THE AIR OVER A LARGE SURFACE AREA FOR CONTACT WITH THE SPIRALING WATER. THE RAPID MIXING OF THE AIR AND WATER UNDER PRESSURE DISSOLVES THE AIR INTO THE WATER. ANY AIR WHICH IS NOT DISSOLVED COLLECTS IN THE AIR POCKET OR CENTER VORTEX IN THE TUBE (D) AND EXCESS AIR IS REMOVED BY THE "BLEED-OFF" VENT (E). THE DISSOLVING TUBE CAN BE INSTALLED IN EITHER THE HORIZONTAL OR VERTICAL POSITION. THE TUBE SIZE AND QUANTITY OF PANELS VARY IN ORDER PROVIDE A RANGE OF ADT SIZES TO MEET SPECIFIC FLOW REQUIREMENTS.

KROFTA	AIR DISSOLVING TUBE FUNCTIONAL DESCRIPTION	DATE: OCTOBER 17, 1991
		DWN: PLN / NO SCALE
		DWG: U4-DT-209



COMPONENTS (SEE ADT OUTLINE DWG. FOR TUBE DIMENSIONS)

- * 1) TUBE BODY
- * 2) 150 LB. FLANGES
- * 3) INLET NOZZLE
- * 4) AIR DISPERSION PANEL
- * 5) AIR FLOW METER W/NEEDLE VALVE
- 6) 3/8" TYP. AIR TUBING
- ** 7) BALL OR GATE VALVE
- * 8) CHECK VALVE
- * 9) PRESSURE GAUGE
- * 10) BLEED-OFF SIGHT TUBE
- ** 11) SAFETY VALVE - 100 PSI
- ** 12) AIR REG., AIR & OIL FILTER
- 13) COUPLING
- 14) UNION
- ** 15) PANEL / ENCLOSURE

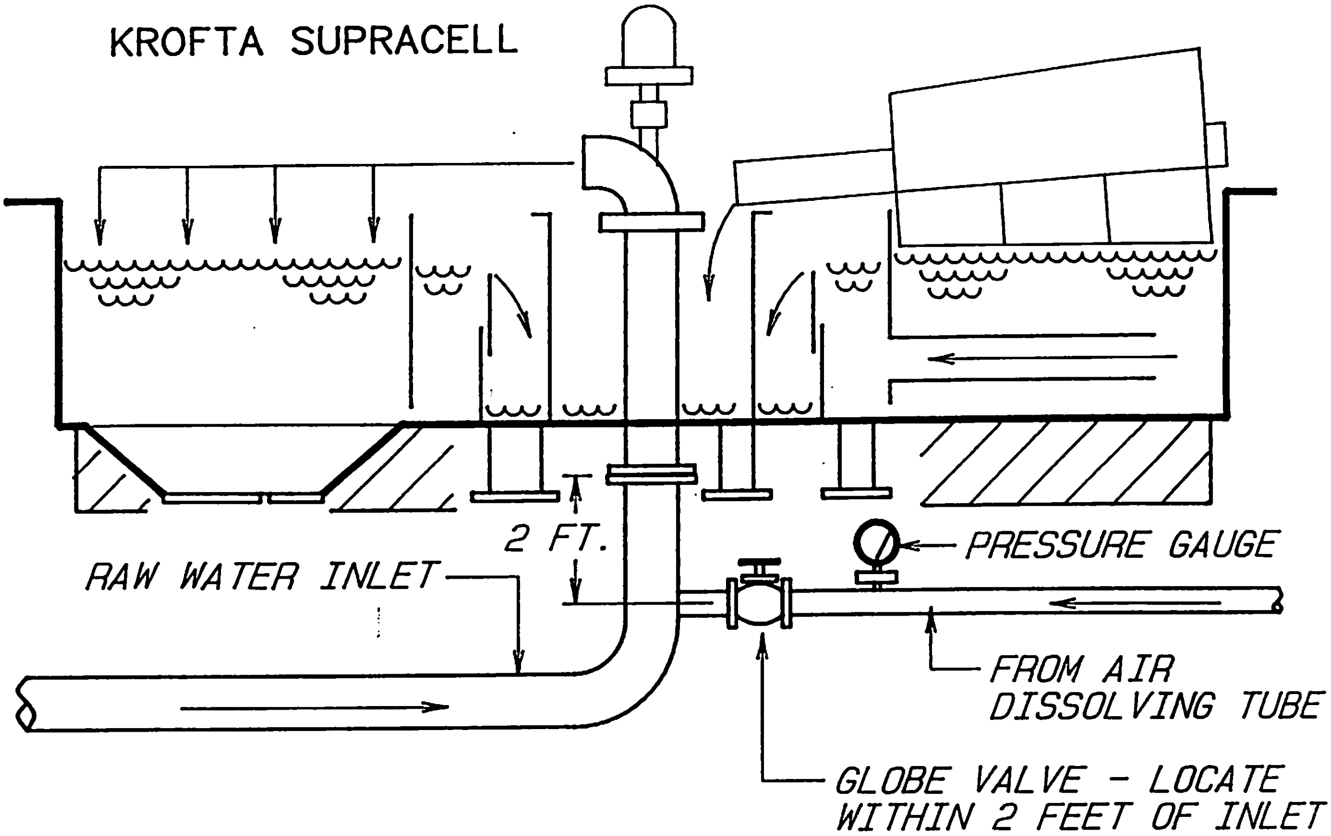
* KROFTA STANDARD SUPPLY
** KROFTA OPTIONAL SUPPLY

NOTE: QUANTITY OF ITEMS #4, 5, 6, 7, 8, 13, 14 VARY ACCORDING TO ADT SIZE AS FOLLOWS: ADT 60, 150, 300, 500, 750 = QTY SHOWN, ADT 1000 = x 2, ADT 1500 = x 3, ADT 2000, 2500 = x 4, ADT 3000, 3500 = x 6.

KROFTA

AIR DISSOLVING TUBE COMPONENT AND INSTALLATION DRAWING

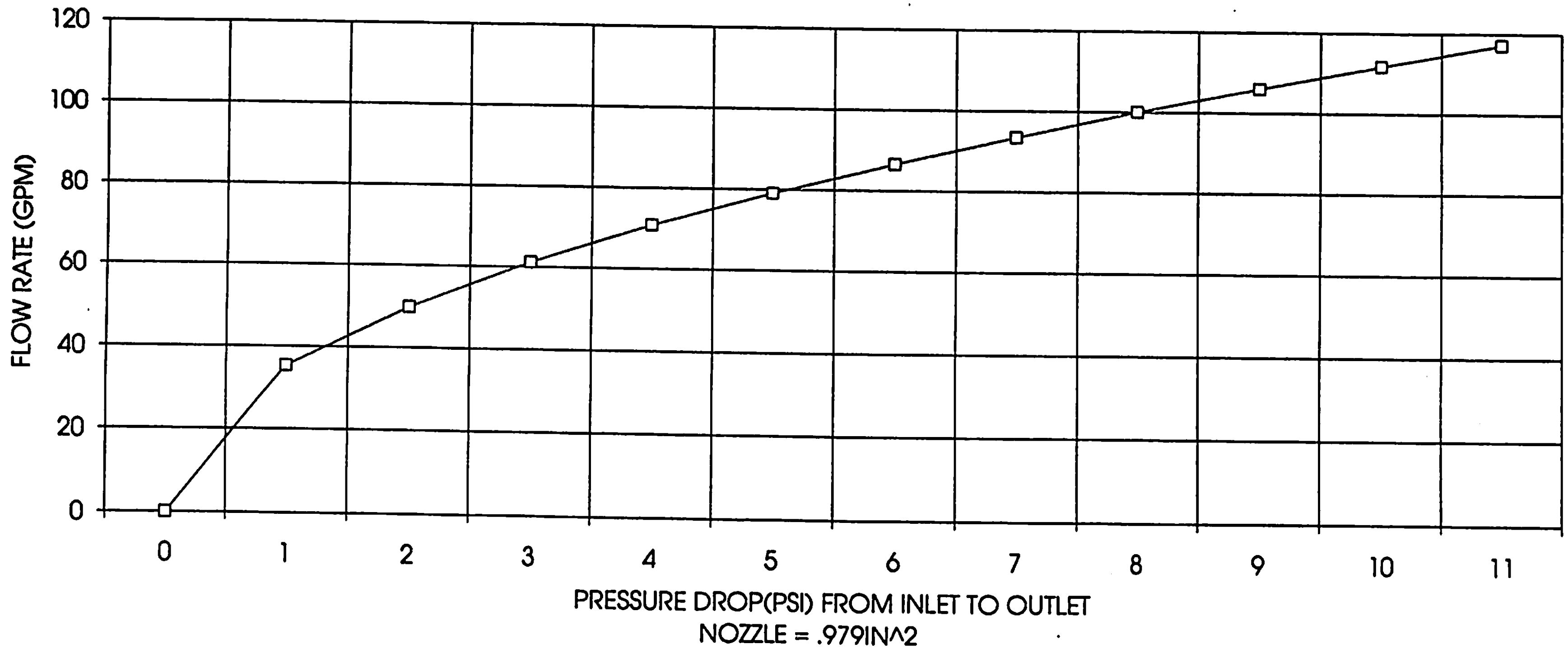
DRN. PLN	
OCT. 11/91	SCALE DNS
DWG. U4-DT-205	

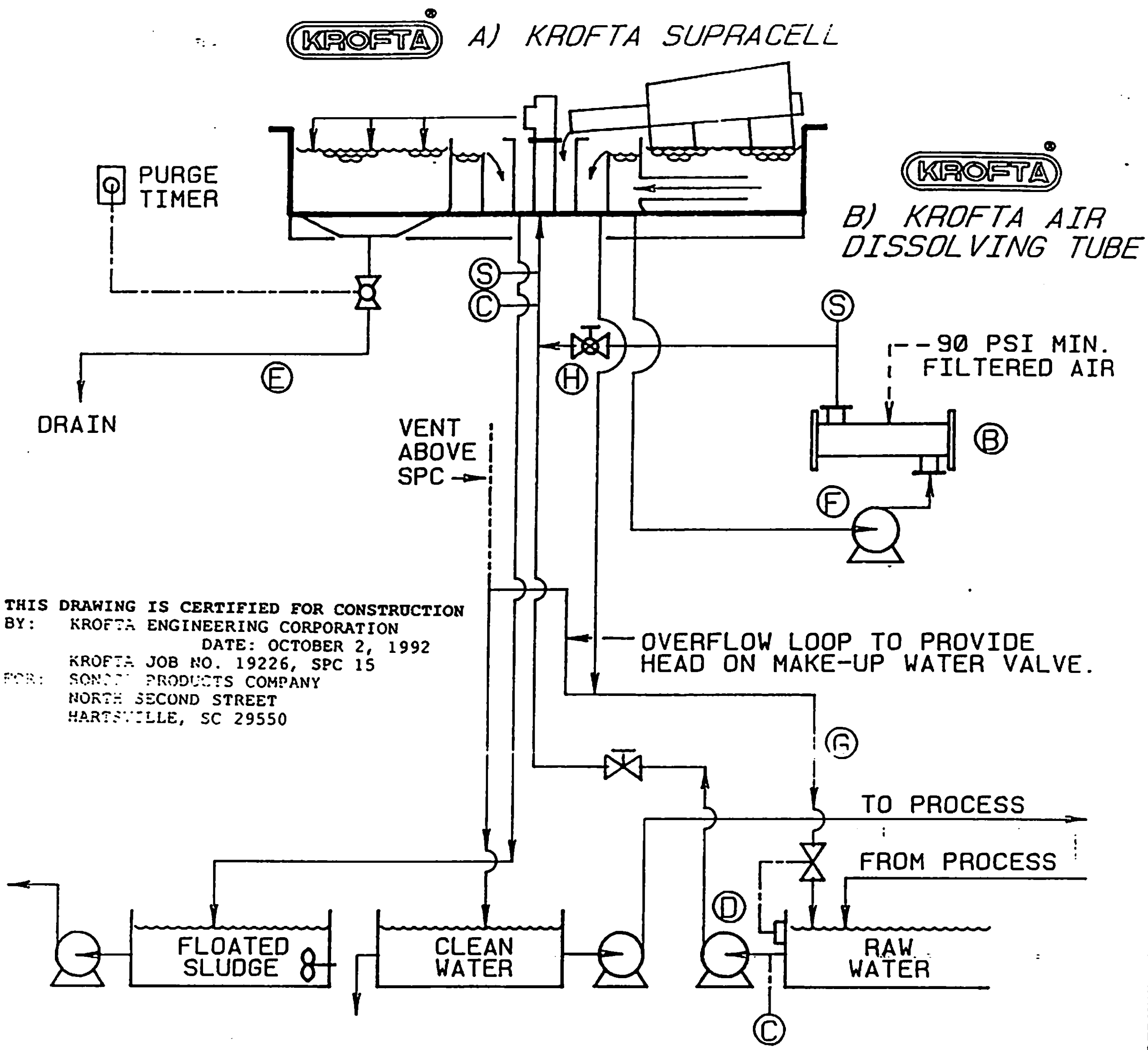


THE PRESSURE RELEASE SYSTEM FOR A SINGLE ROTARY JOINT TYPE SUPRACELL UTILIZES A GLOBE VALVE TO CONTROL THE FLOW FROM THE AIR DISSOLVING TUBE TO THE SUPRACELL. THE NARROW GAP FORMED BY THE GLOBE VALVE SEAT SURFACES IS WHAT PROVIDES THE NECESSARY 'SHEAR' OF THE WATER STREAM CAUSING THE DISSOLVED AIR TO COME OUT OF SOLUTION AND FORM MICROSCOPIC BUBBLES. TO MINIMIZE THE TIME BEFORE THE BUBBLES REACH THE FLOTATION ZONE OF THE UNIT, THE GLOBE VALVE MUST BE LOCATED AS CLOSE TO THE RAW WATER INLET AS POSSIBLE. ANOTHER FUNCTION OF THE VALVE IS TO CONTROL THE PRESSURE AND FLOW FROM THE A.D.T. A PRESSURE VALVE IS PROVIDED FOR MOUNTING AHEAD OF THE VALVE TO ASSIST CORRECT VALVE ADJUSTMENT. IF THE VALVE IS NOT PROVIDED WITH THE SUPRACELL, ONE MUST BE CHOSEN THAT IS RATED FOR THROTTLING SERVICE WITH HARD SEAT AND DISC SURFACES TO RESIST WEAR.

KROFTA	KROFTA SUPRACELL SINGLE JOINT GLOBE VALVE TYPE PRESSURE RELEASE SYSTEM	DEC. 30, 1991
		DWN: PLN
		DWG. U4-DT-213

ADT 500 FLOW MEASUREMENT GRAPH
NOMINAL FLOW 100 GPM, AT 8 PSI
KROFTA JOB #19226





THIS DRAWING IS CERTIFIED FOR CONSTRUCTION
BY: KROFTA ENGINEERING CORPORATION
DATE: OCTOBER 2, 1992
KROFTA JOB NO. 19226, SPC 15
FOR: SONOCO PRODUCTS COMPANY
NORTH SECOND STREET
HARTSVILLE, SC 29550

A) KROFTA SUPRACELL, SPC 15.
B) KROFTA AIR DISSOLVING TUBE, TYPE 500.
C) CHEMICAL FEED POINT.
D) INFLUENT FEED; 400 GPM AT 8 FT/HD MIN. ABOVE SPC BASE LEVEL.
E) AUTOMATIC BOTTOM PURGE VALVE; 4" VALVE WITH TIMER AND SOLENOID.
F) PRESSURE PUMP; 100 GPM AT 180 FT/HD AT ADT INLET FLANGE.
G) AUTOMATIC CLARIFIED WATER MAKE-UP.
H) PRESSURE RELEASE GLOBE VALVE, 2.1/2" MINIMUM DIA. LOCATE WITHIN TWO FEET OF SPC INLET FLANGE.
S) SAMPLE POINT.

RECYCLE FLOW - SINGLE ROTARY JOINT

KROFTA®	KROFTA SUPRACELL TYPE SPC 15 FLOW SCHEMATIC	BY: G.A.ROSE DATE: OCT. 1, 1992 DWG: U4-SPC-1284