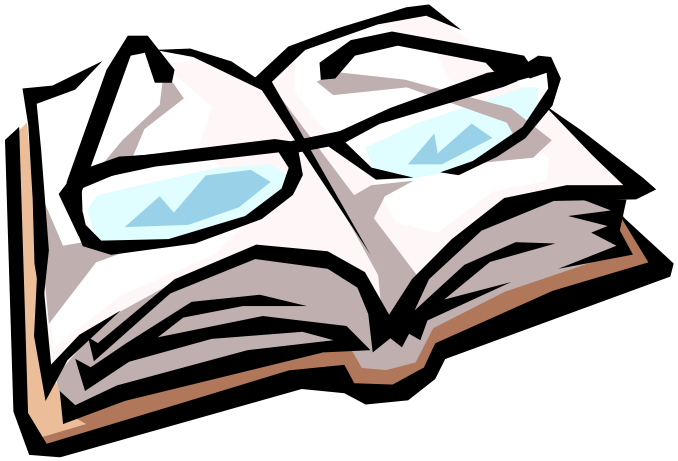
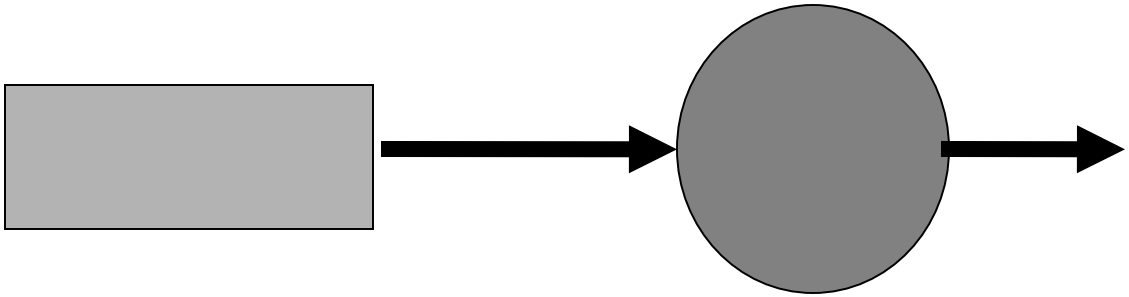
QUICK REVIEW



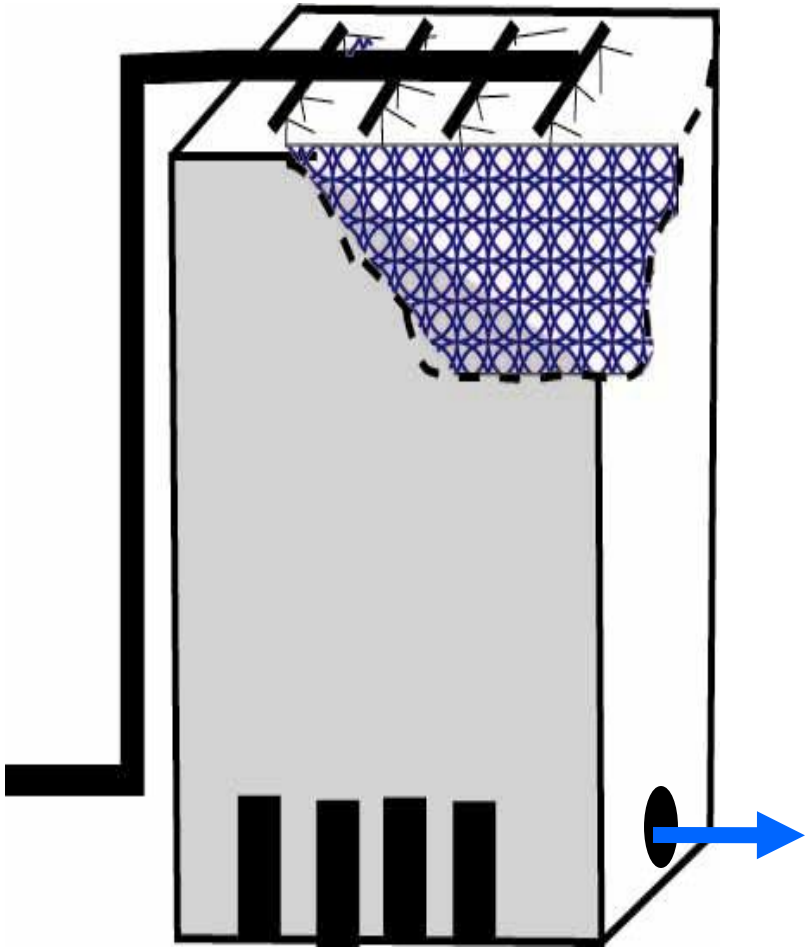


SECONDARY TREATMENT

- WASTE TREATMENT PONDS
- TRICKLING FILTERS
- ROTATING BIOLOGICAL CONTACTORS
- ACTIVATED SLUDGE

TRICKLING FILTERS

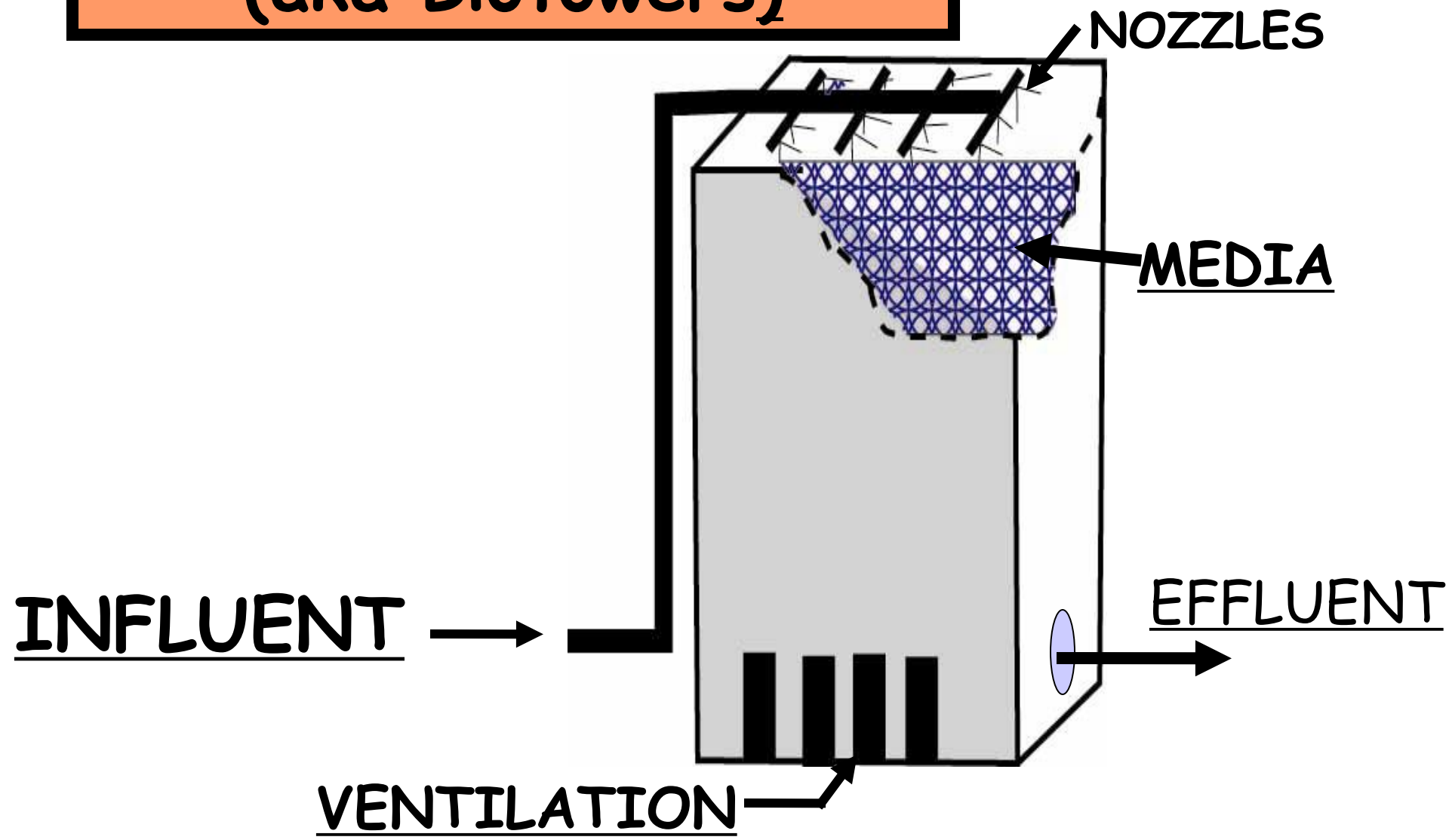
ROTATING DISTRIBUTOR



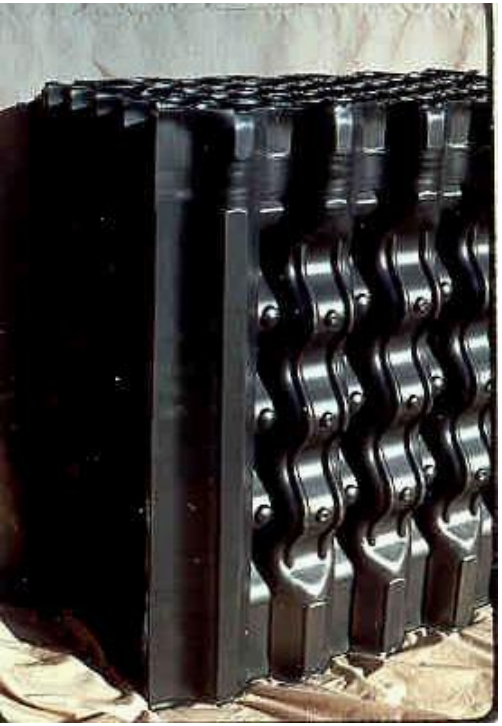
FILTER TOWER

FILTER TOWERS

(aka Biotowers)



FILTER TOWER MEDIA



PLASTIC MEDIA

ALL TRICKLING FILTERS CONSIST OF 3 PARTS

- MEDIA
- UNDERDRAIN
- DISTRIBUTION SYSTEM

TRICKLING FILTERS COULD BE CALLED…

"ATTACHED GROWTH BIOLOGICAL REACTORS"

MEDIA

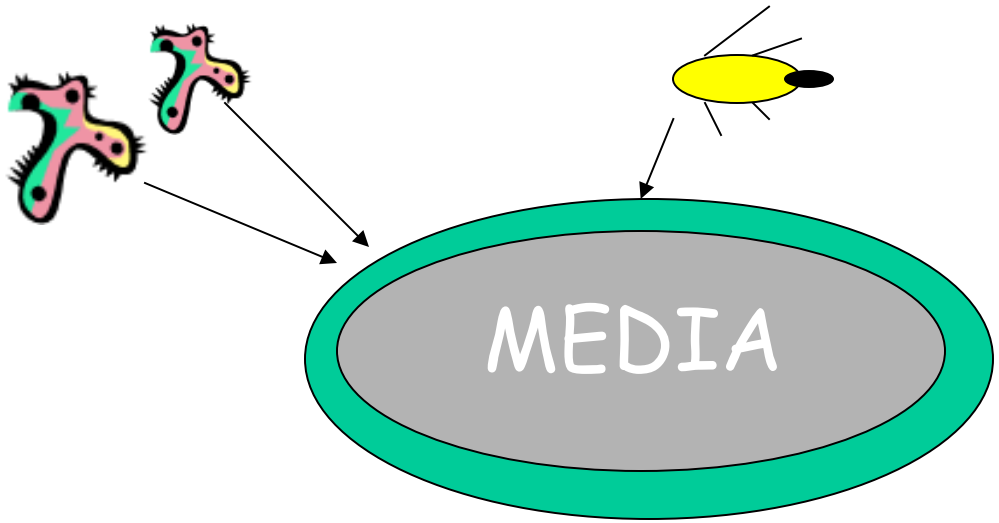
FUNCTION

·PROVIDES A PLACE FOR BIOLOGICAL SLIME TO DEVELOP

SLIME: aka ZOOGLEAL FILM

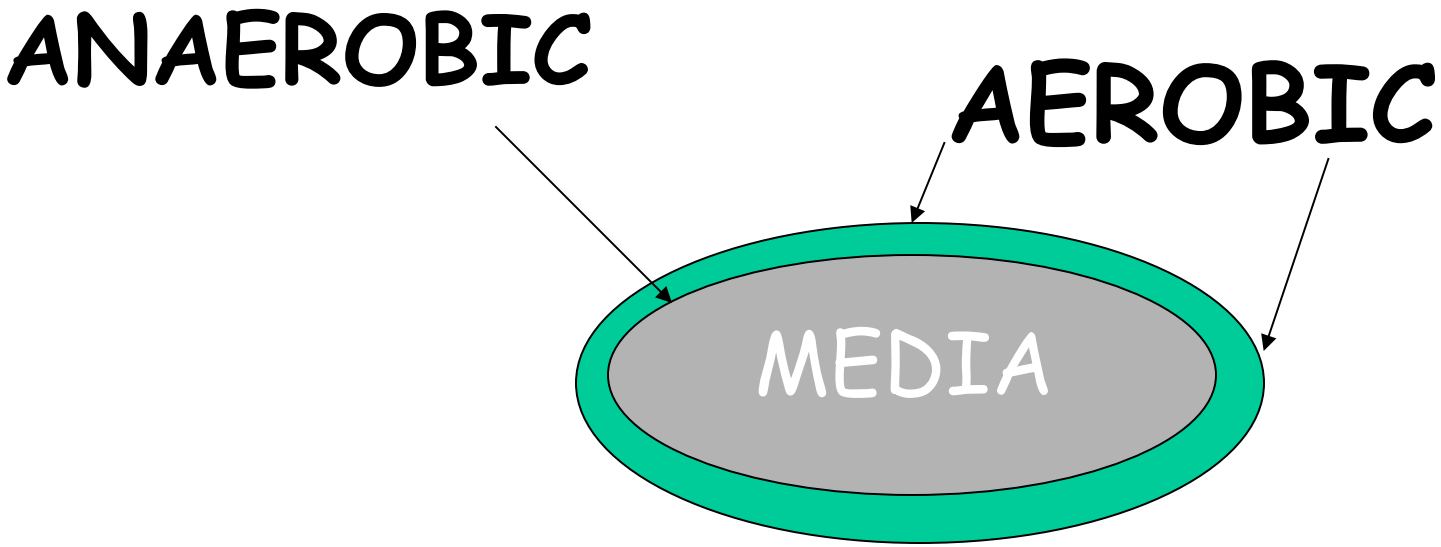
(ZOE-glee – al)

ZOOGLEAL FILM



CONSISTS OF BACTERIA, ALGAE
PROTOZOA, FUNGI, WORMS…+?

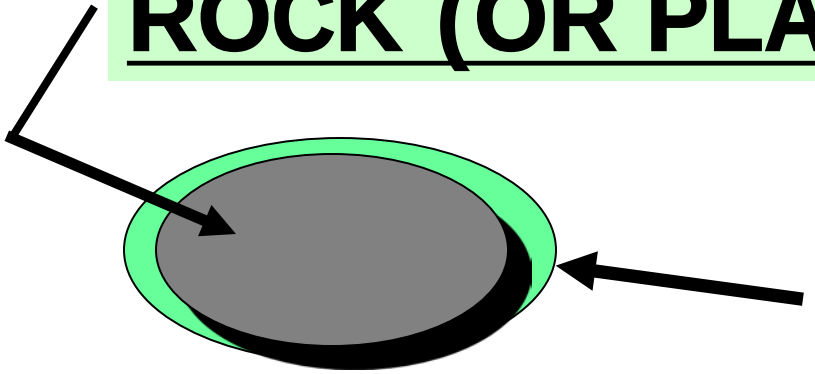
ZOOGLEAL FILM



THE PROCESS IS AEROBIC—EVEN WITH AN ANAEROBIC LAYER NEXT TO THE MEDIA

TRICKLING FILTER

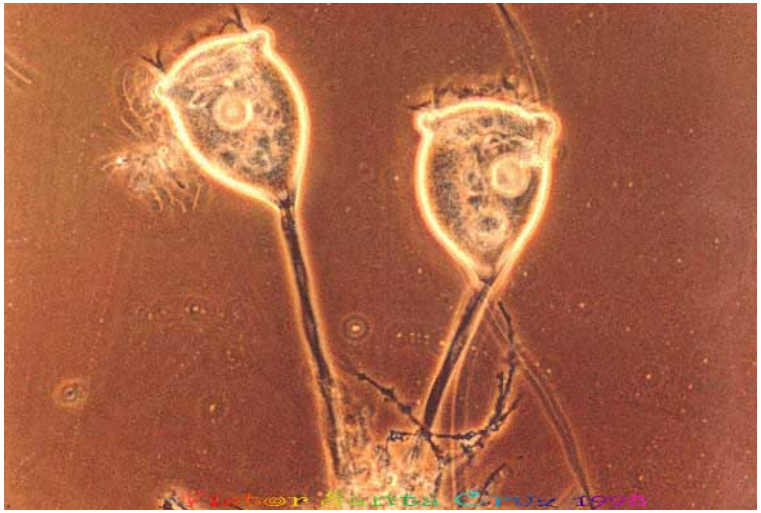
ROCK (OR PLASTIC)



HUMUS

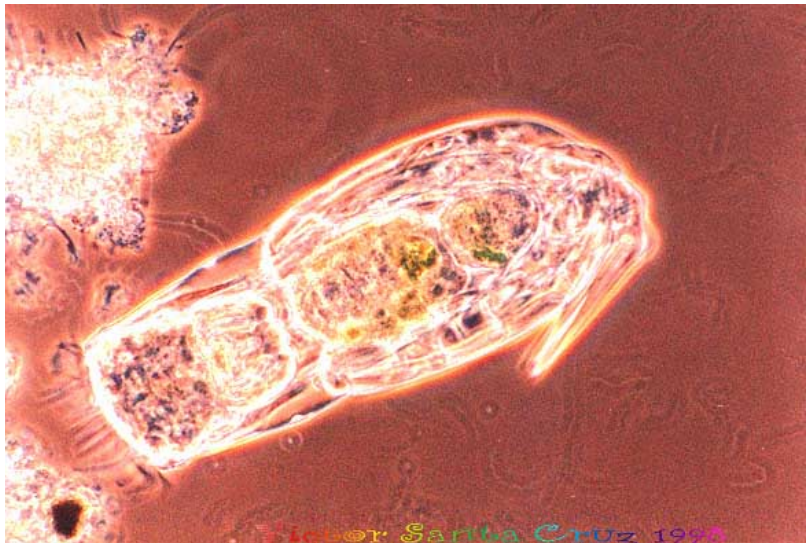
HUMUS (SLOUGHING BIOMASS) GOES TO THE CLARIFIER

SOME ZOOGLEAL CRITTERS AT 1000 X

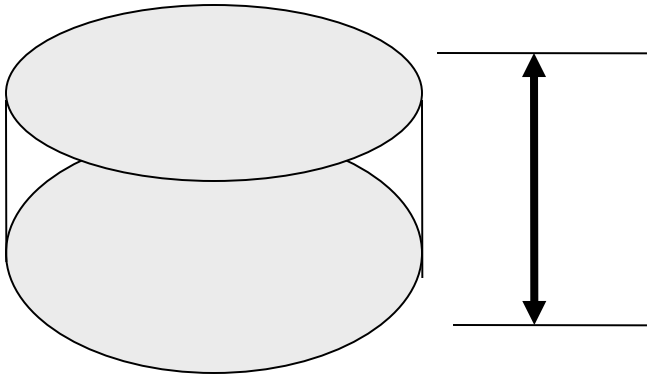


"STALKED" CILIATES

ROTIFER

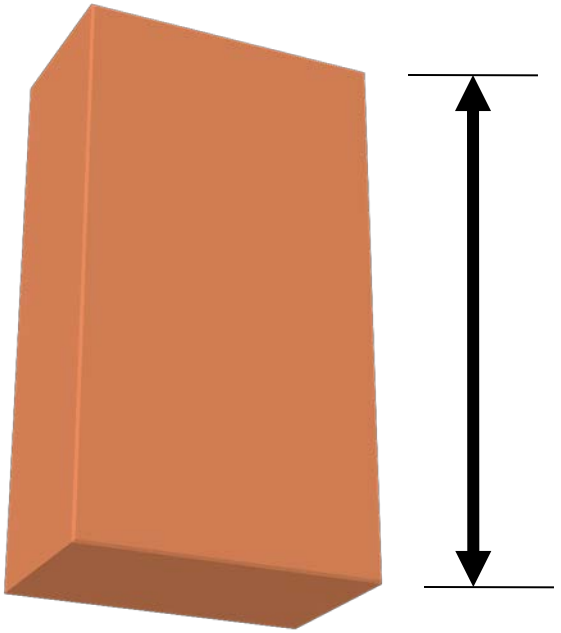


DEPTH OF MEDIA



3-8 FT FOR ROCKS

(DEPTH LIMITED BECAUSE OF WEIGHT OF ROCKS)



15-30 FT FOR SYNTHETIC MEDIA

ALL TRICKLING FILTERS CONSIST OF 3 PARTS…

- MEDIA
- UNDERDRAIN
- DISTRIBUTION SYSTEM

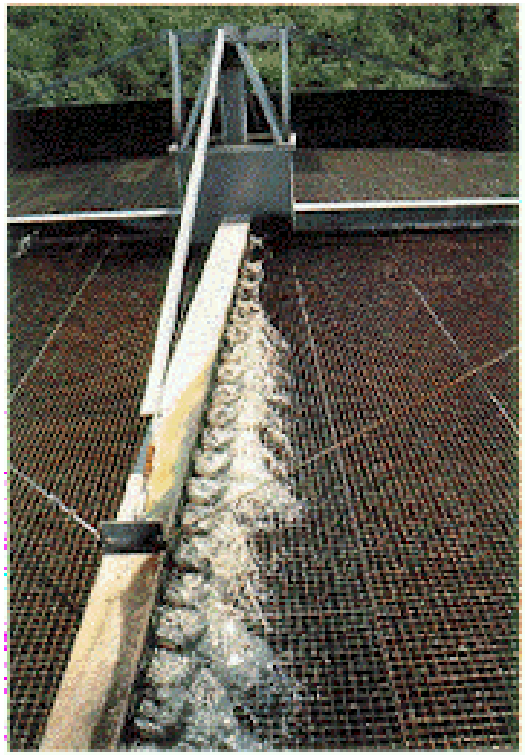
UNDERDRAIN

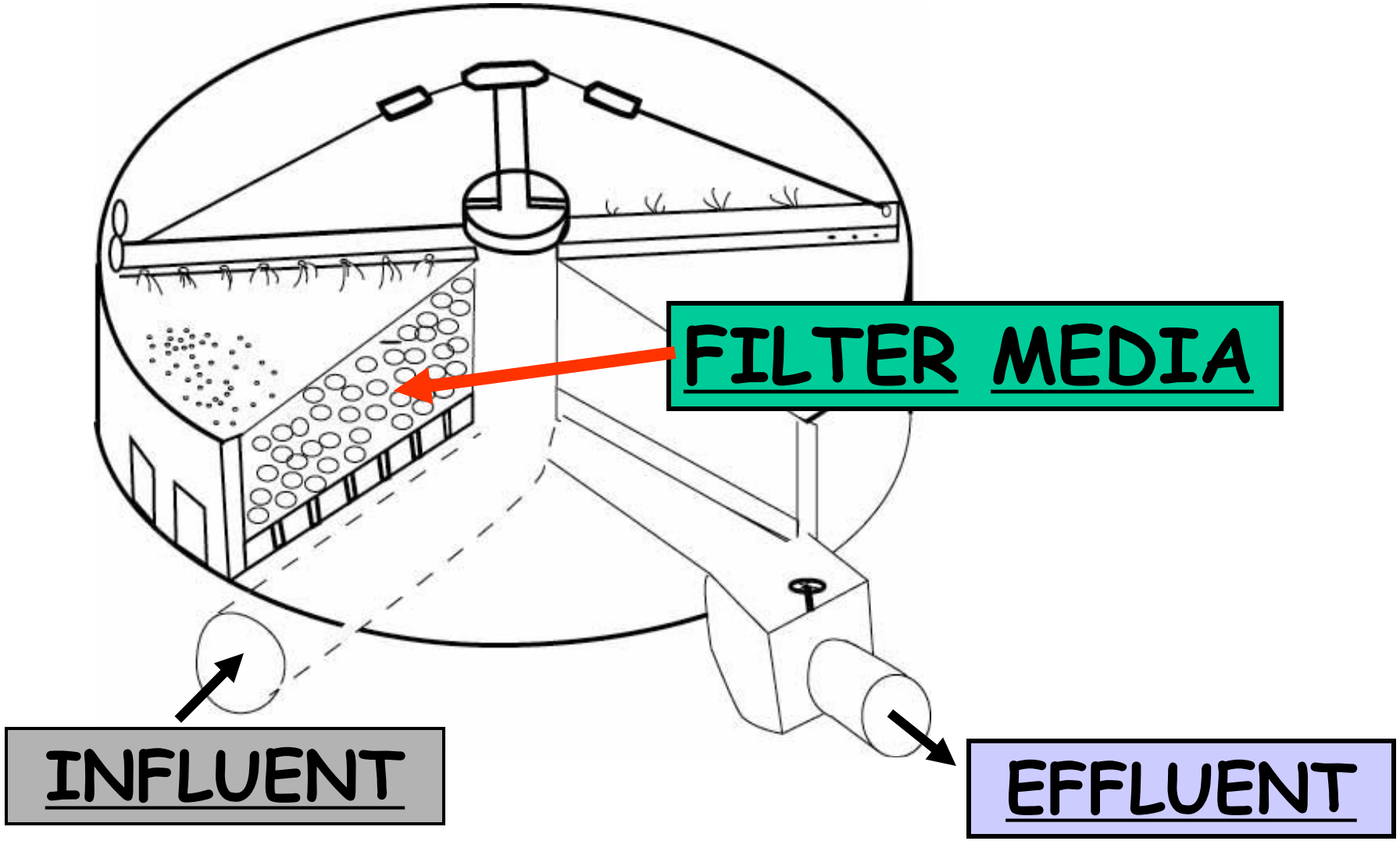
UNDERDRAIN

- THESE ARE DESIGNED TO FLOW ½ FULL AT MAXIMUM FLOW RATES

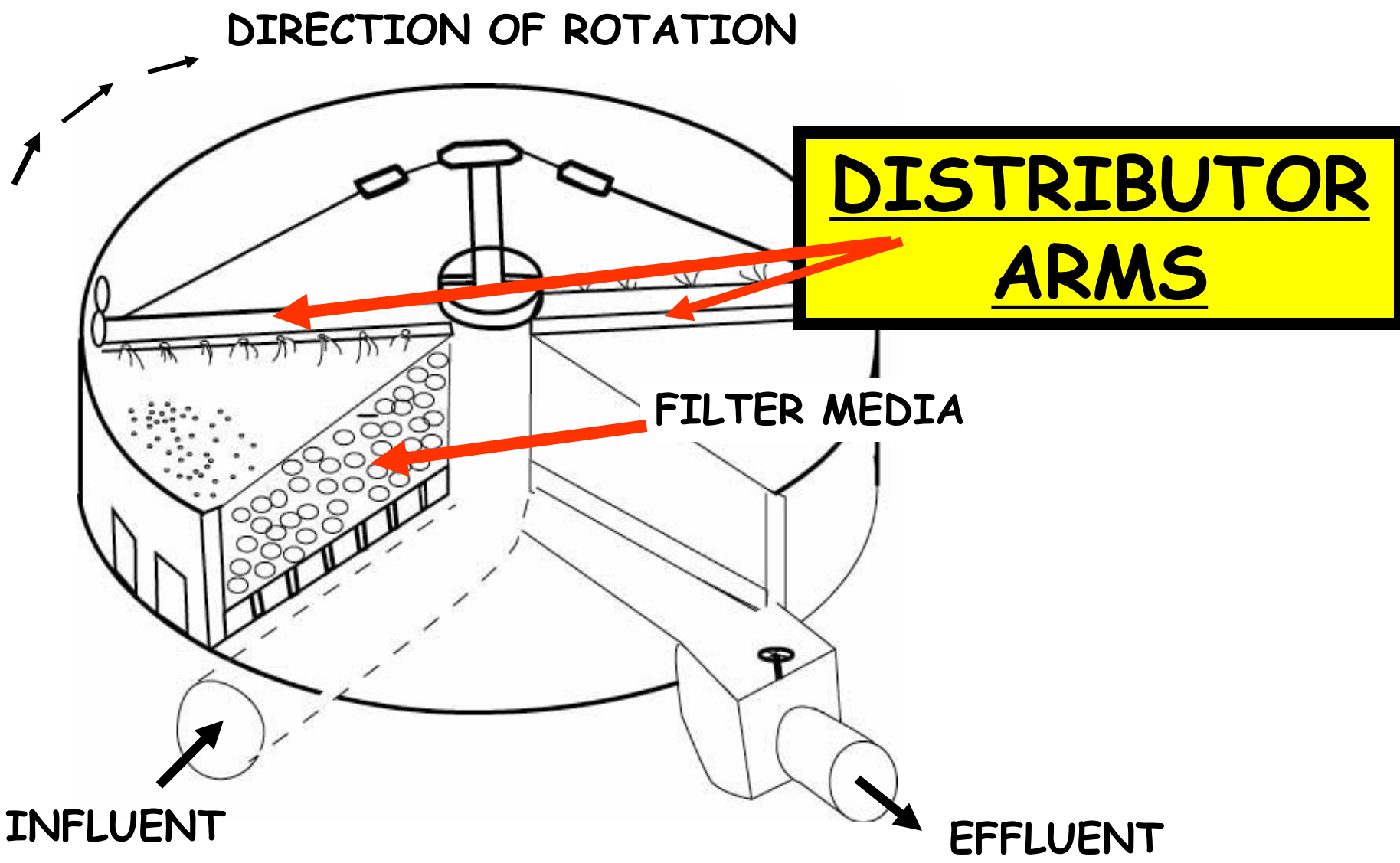
- SLOPED TO DRAIN AT MINIMUM OF 2 fps

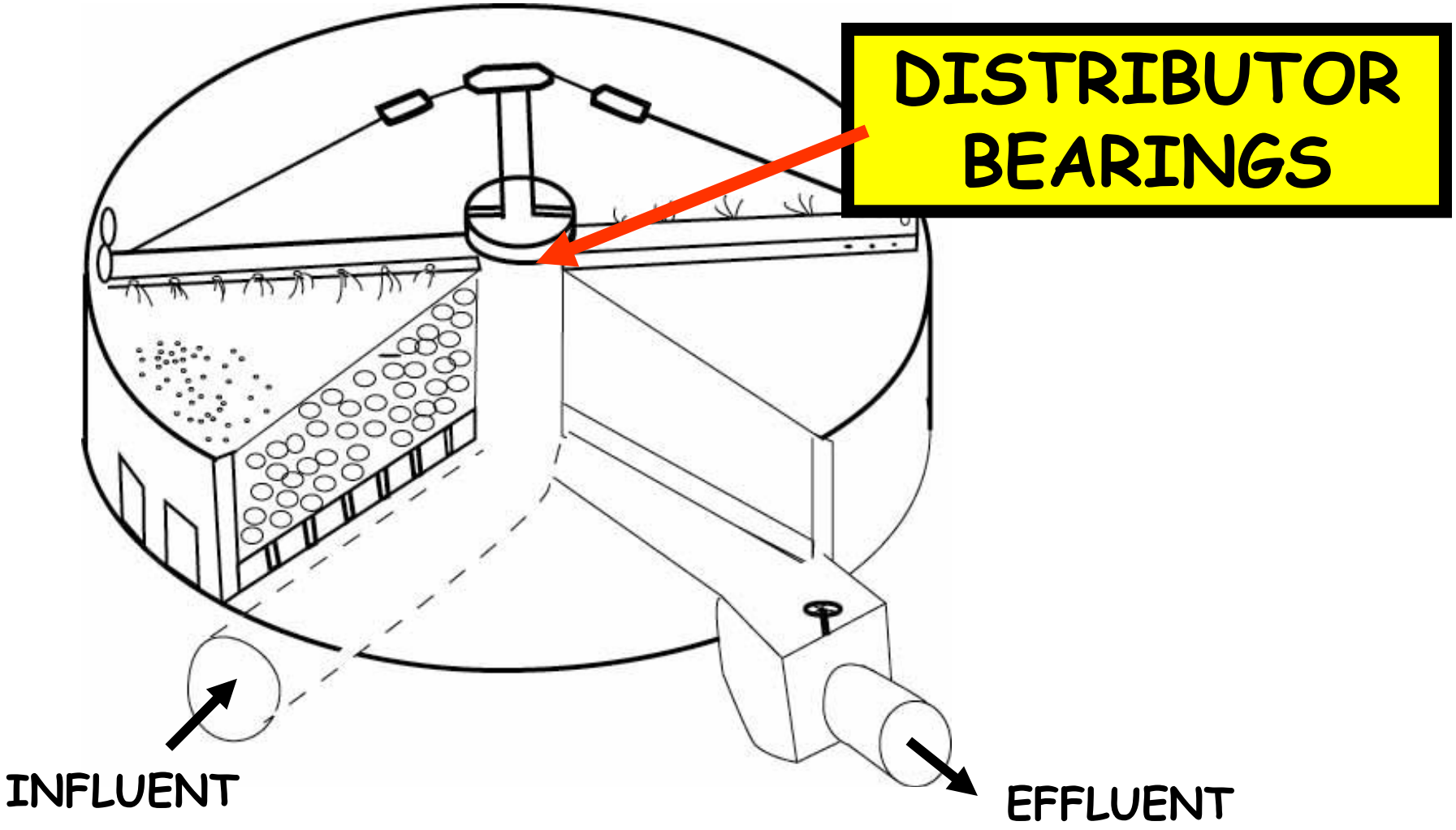
DISTRIBUTION SYSTEM

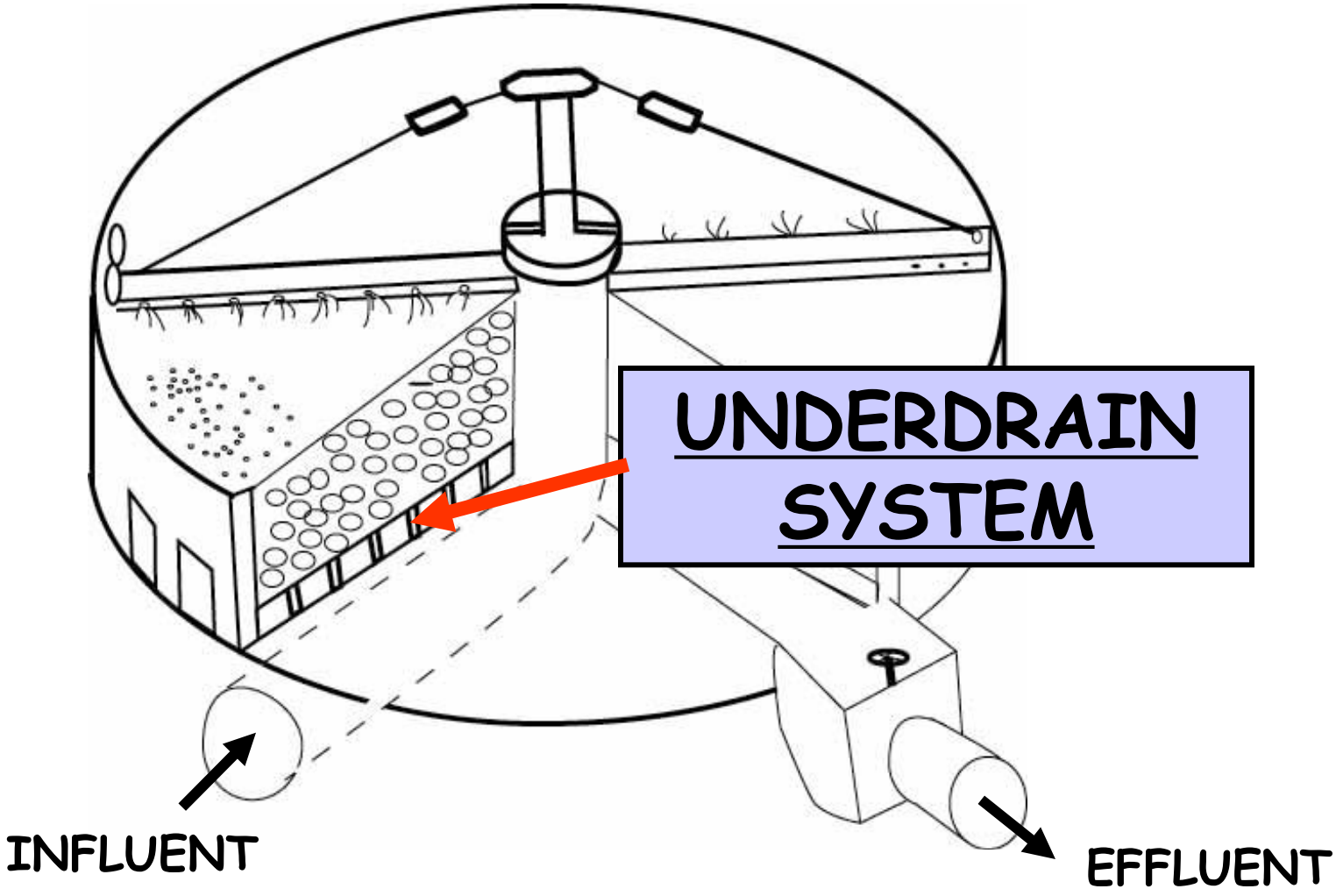


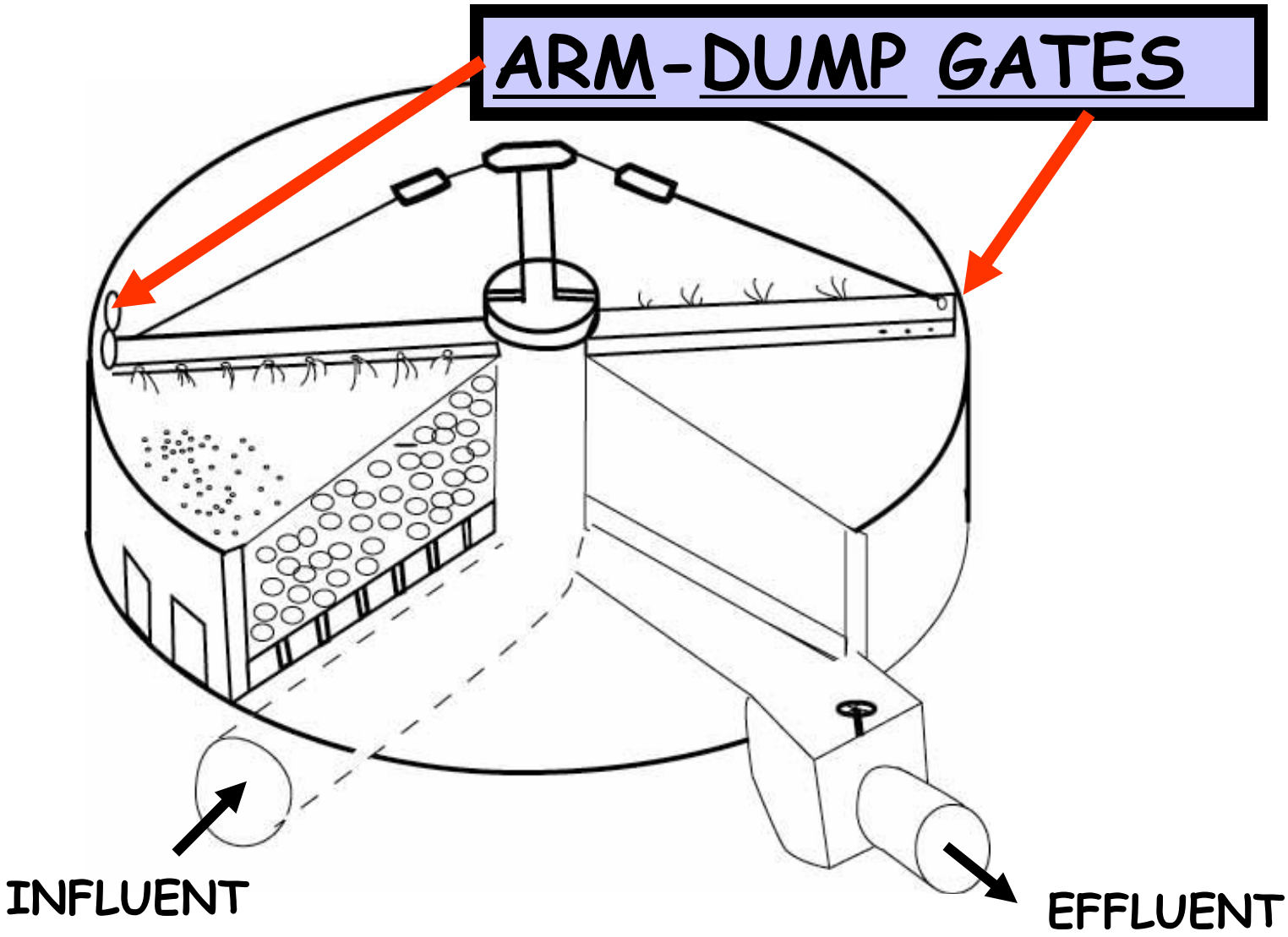


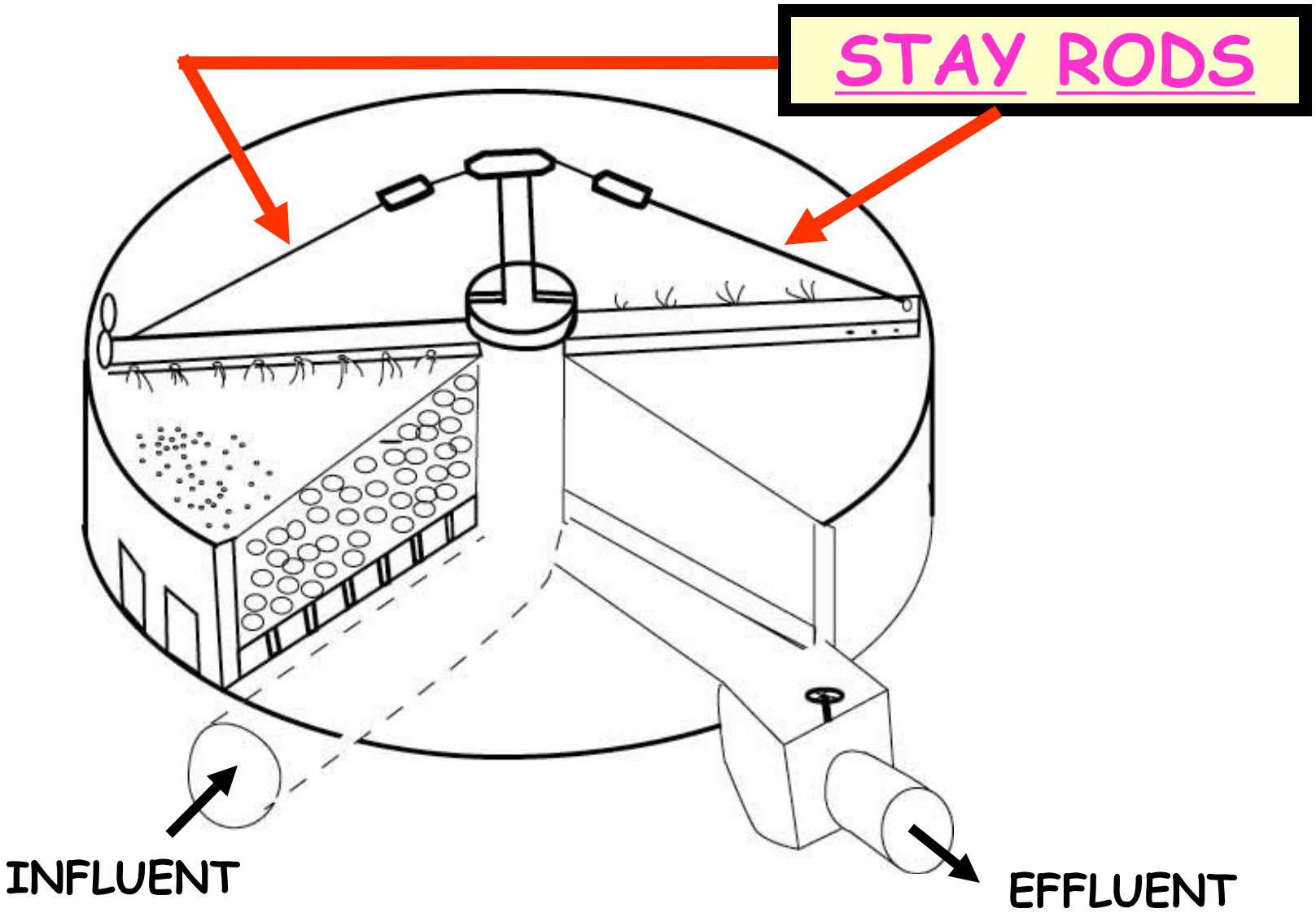
TRICKLING FILTER

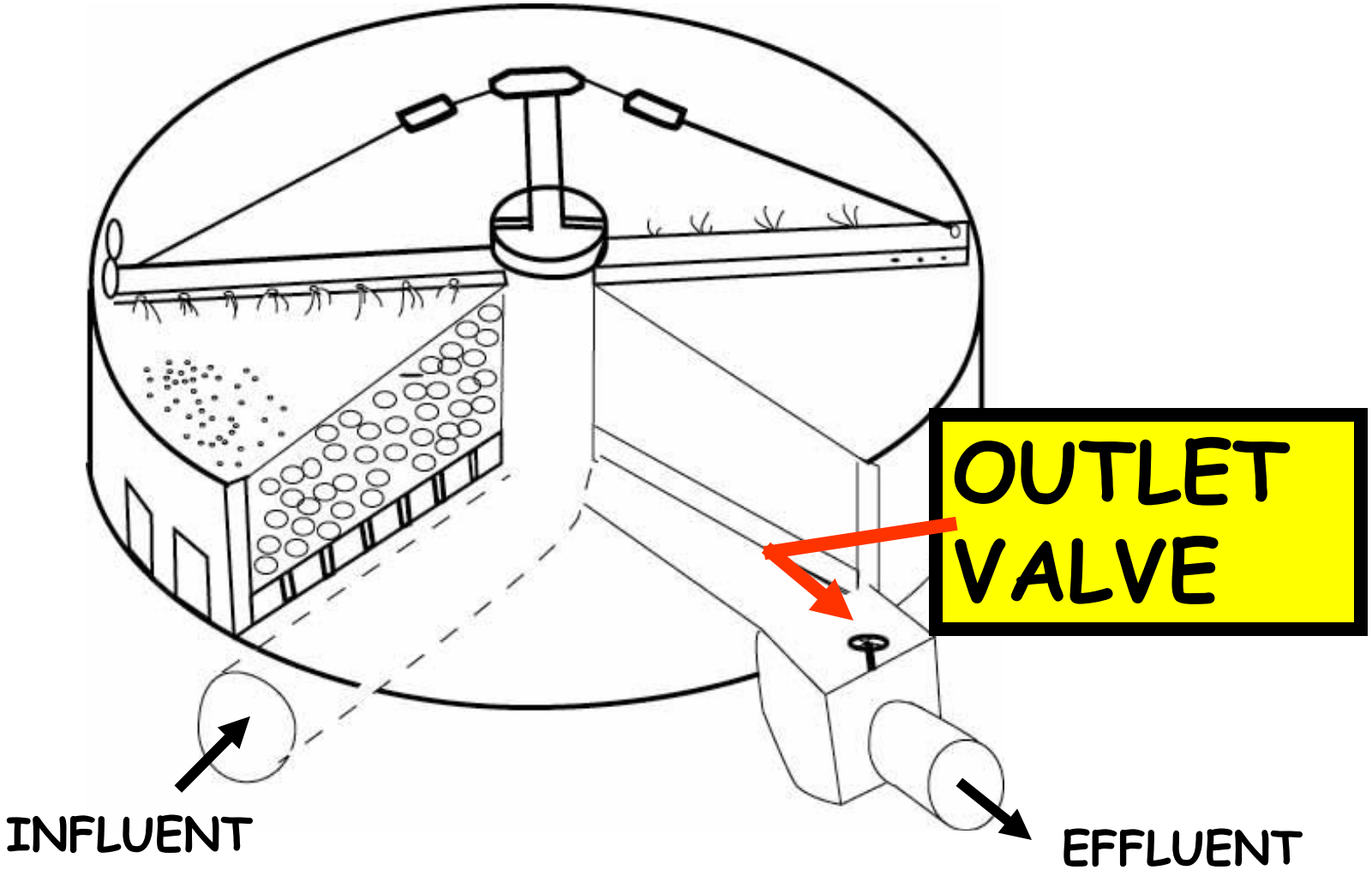

DIRECTION OF ROTATION
DISTRIBUTOR ARMS
FILTER MEDIA
INFLUENT
EFFLUENT

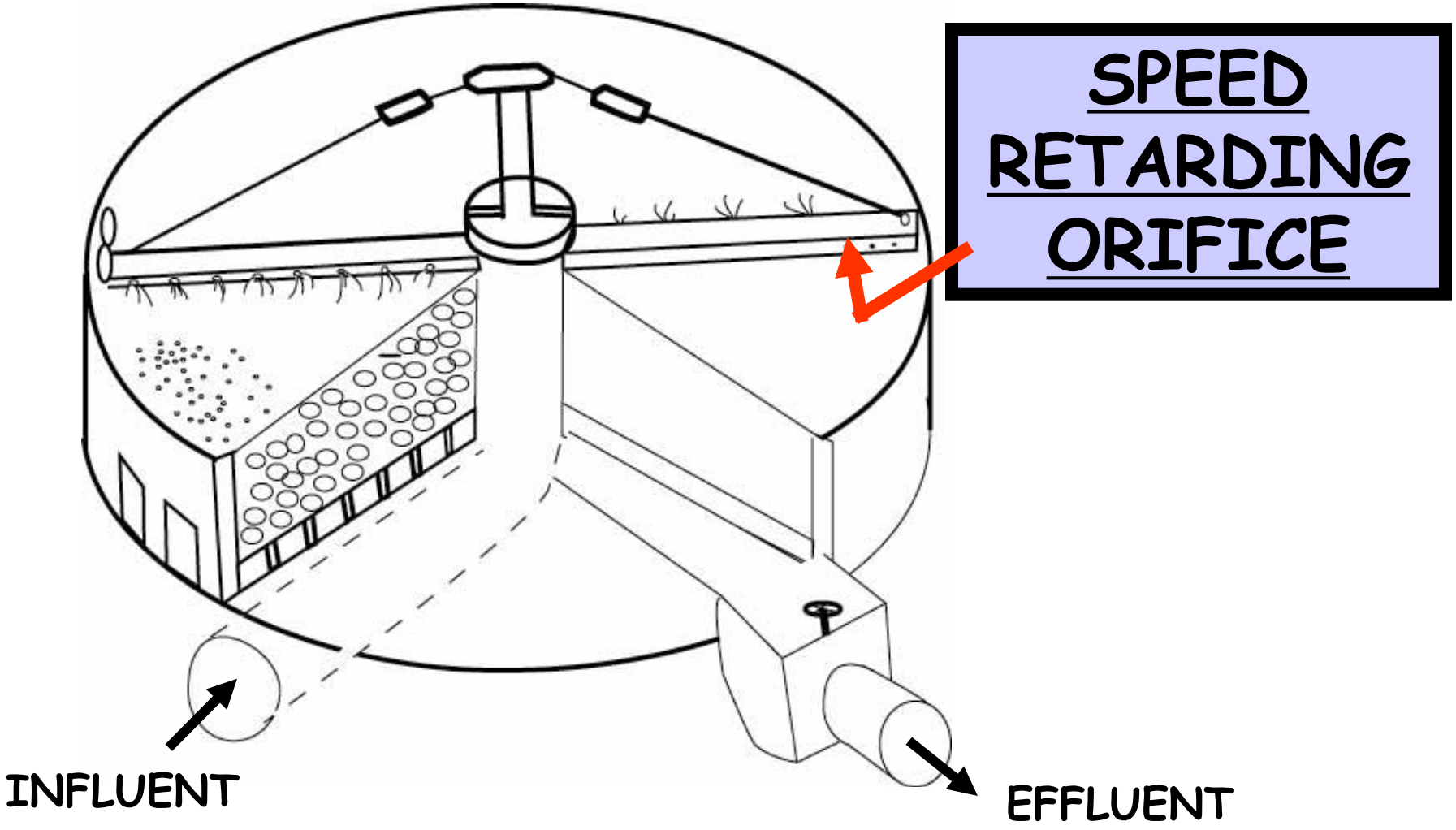

DISTRIBUTOR BEARINGS
INFLUENT
EFFLUENT


UNDERDRAIN SYSTEM
INFLUENT
EFFLUENT

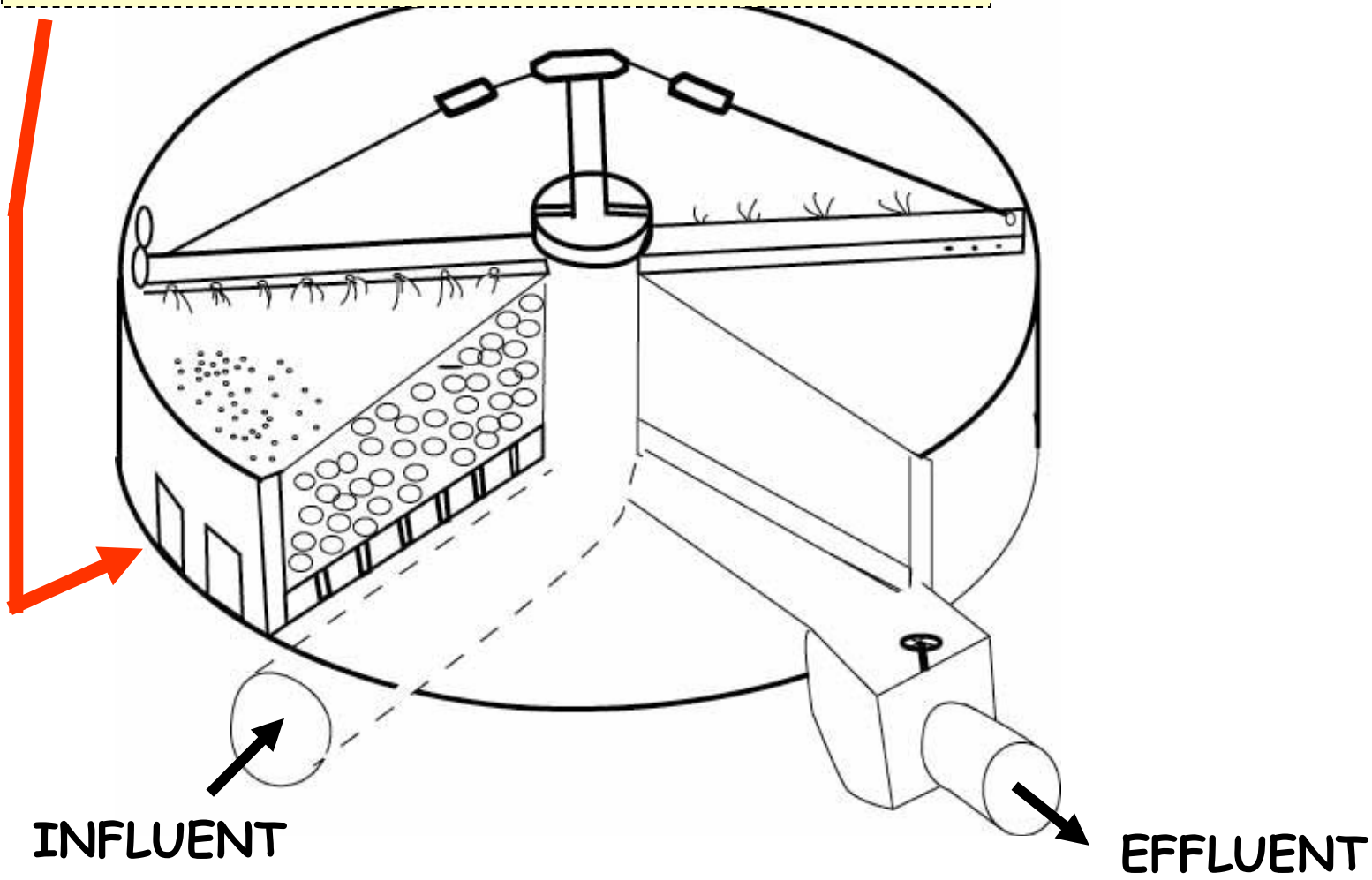

ARM-DUMP GATES
INFLUENT
EFFLUENT


STAY RODS
INFLUENT
EFFLUENT


OUTLET VALVE
INFLUENT
EFFLUENT


SPEED RETARDING ORIFICE
INFLUENT
EFFLUENT

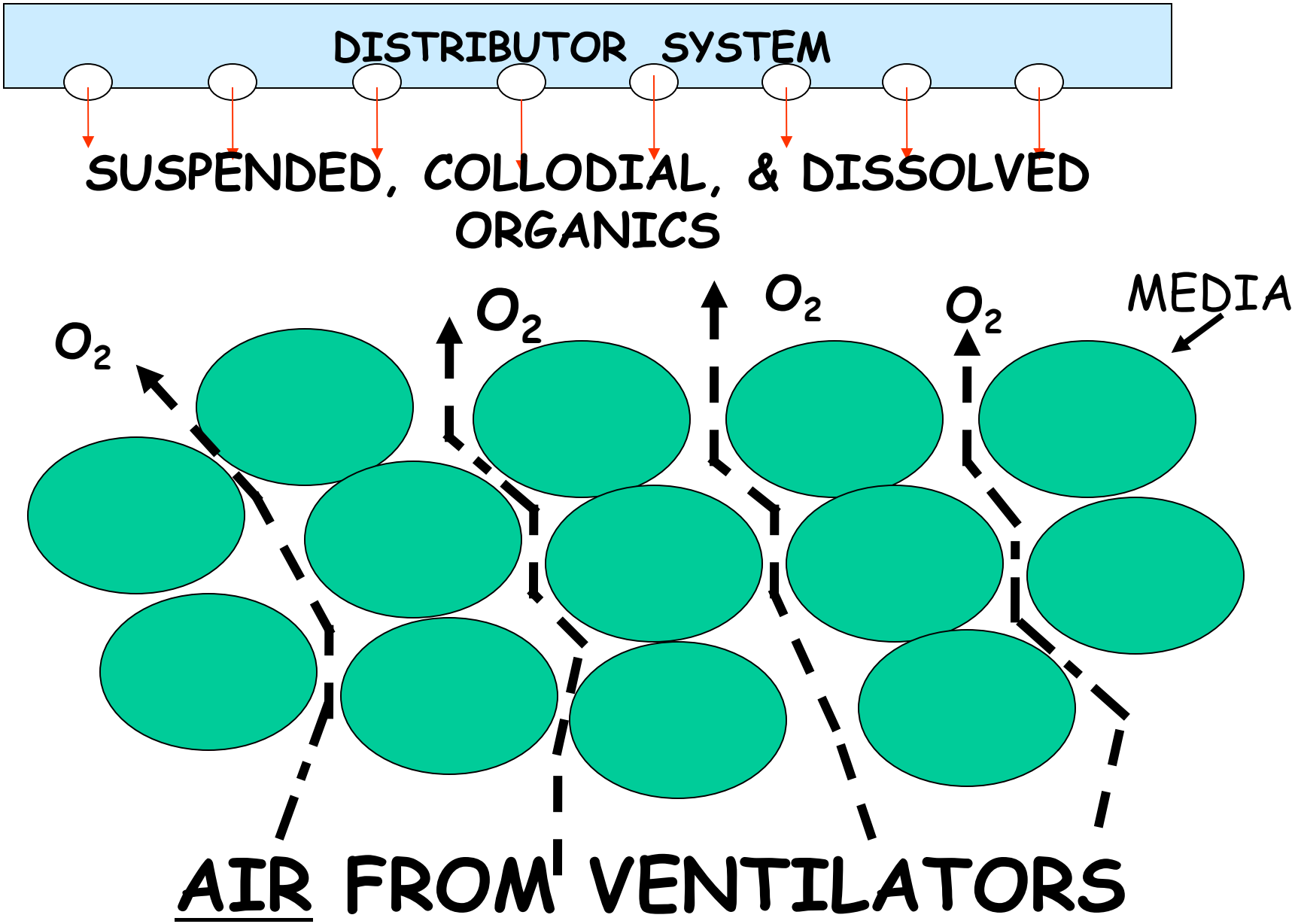
VENTILATION PORTS



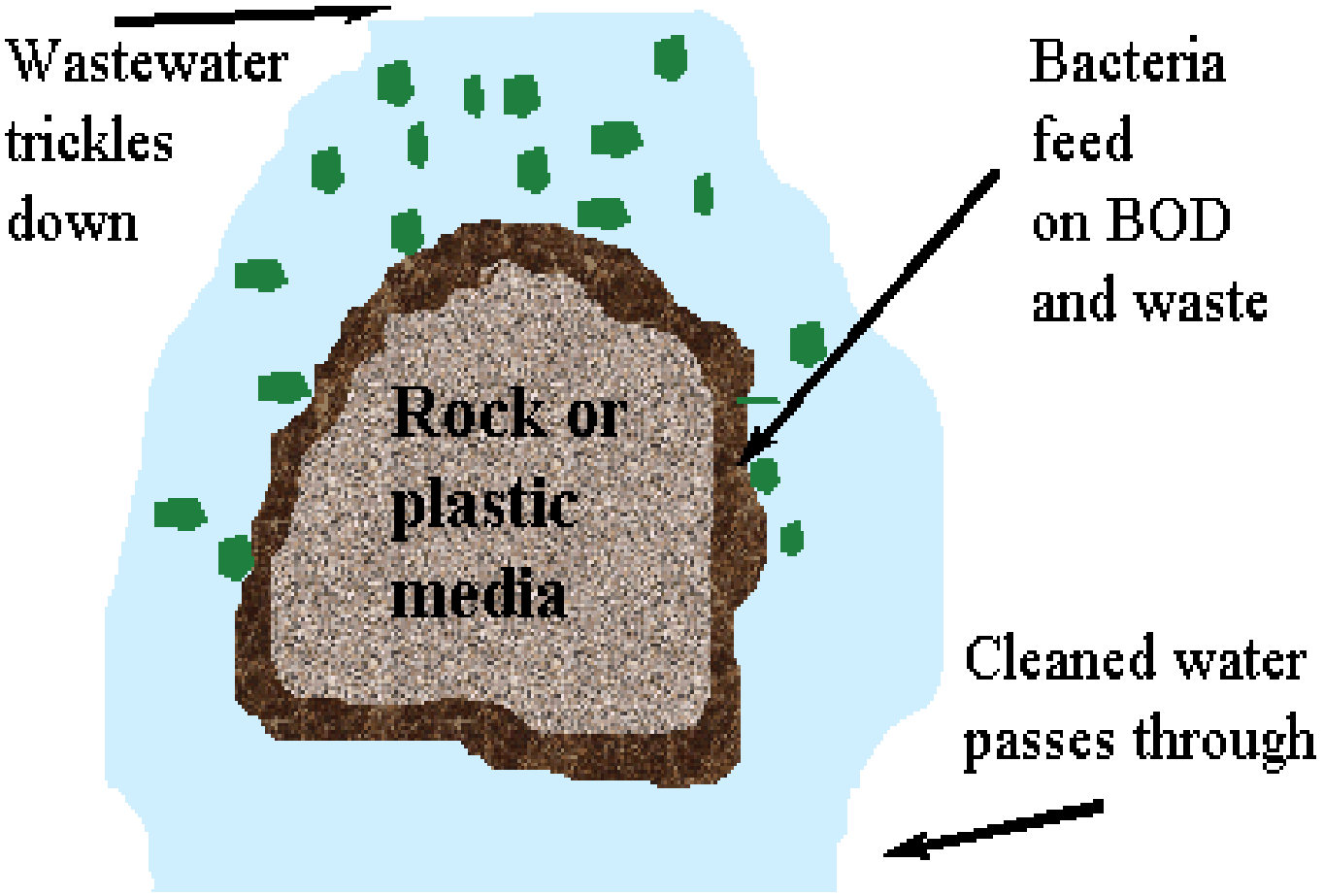
PRINCIPLES OF OPERATION

A TRICKLING FILTER IS NOT A FILTER...(NO STRAINING ACTION)

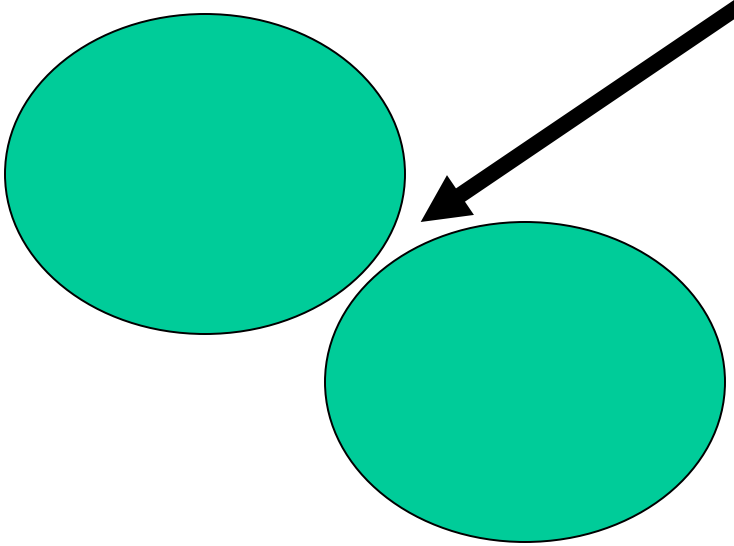
THE "JELLY-LIKE" COATING ON THE MEDIA USES THE ORGANICS IN THE WASTE-WATER AS NUTRIENTS


DISTRIBUTOR SYSTEM
SUSPENDED, COLLODIAL, & DISSOLVED ORGANICS
O_2
O_2
O_2
O_2
MEDIA
AIR FROM VENTILATORS

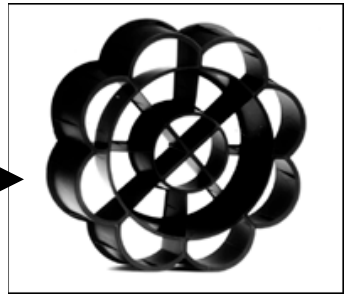
NUTRIENTS + O_2 + SLIME ⟶
NEW SLIME + $\underline{CO_2}$ + $\underline{H_2O}$



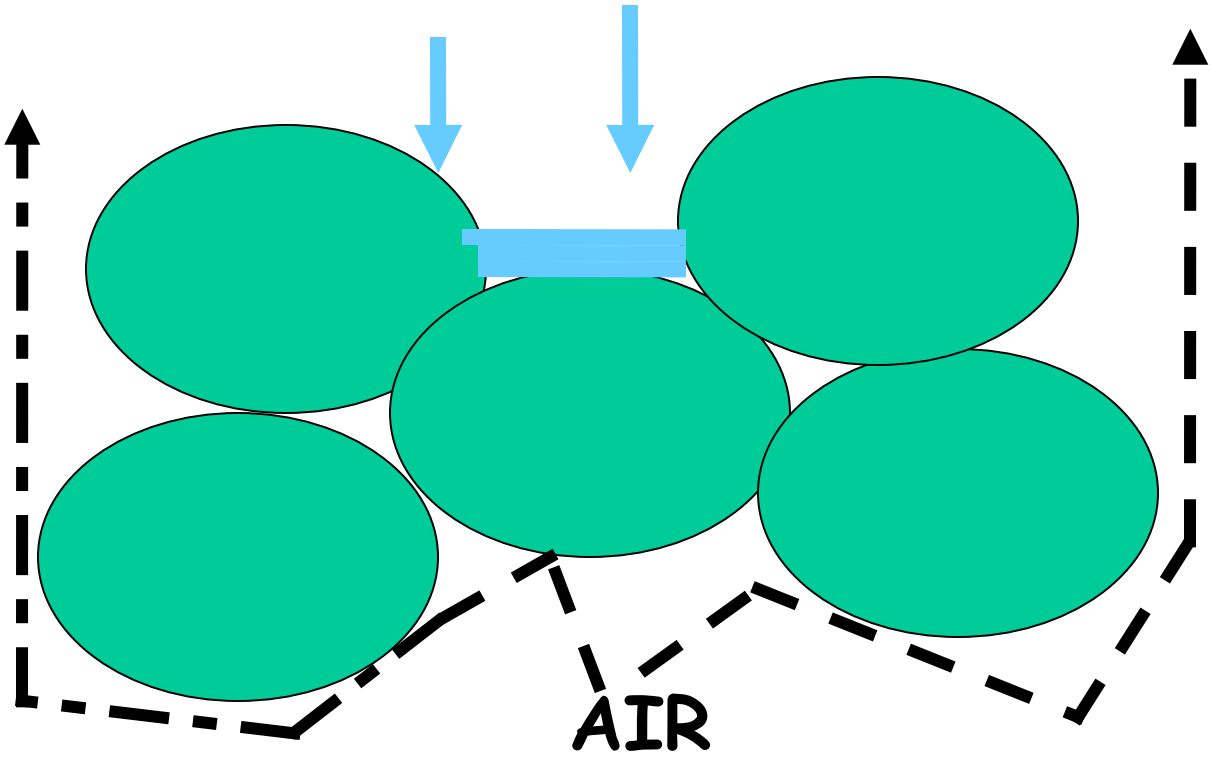
ROCKS PROVIDE ABOUT 35% VOID SPACE



SYNTHETIC MEDIA PROVIDE ABOUT 95% VOID SPACE



PONDING (CLOGGED VOID SPACES



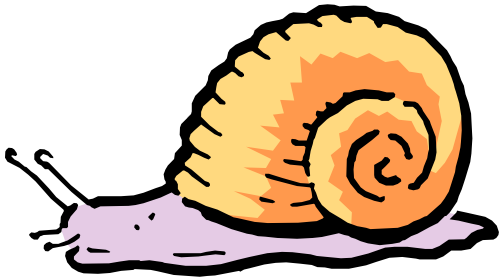
PONDING IS CAUSED BY:

- EXCESSIVE ORGANIC LOADING
- POOR PRIMARY CLARIFICATION
- MEDIA IS TOO SMALL or NOT UNIFORM IN SIZE

(non-uniform media will allow the smaller to fit between the larger and block the void space)

PONDING IS CAUSED BY:

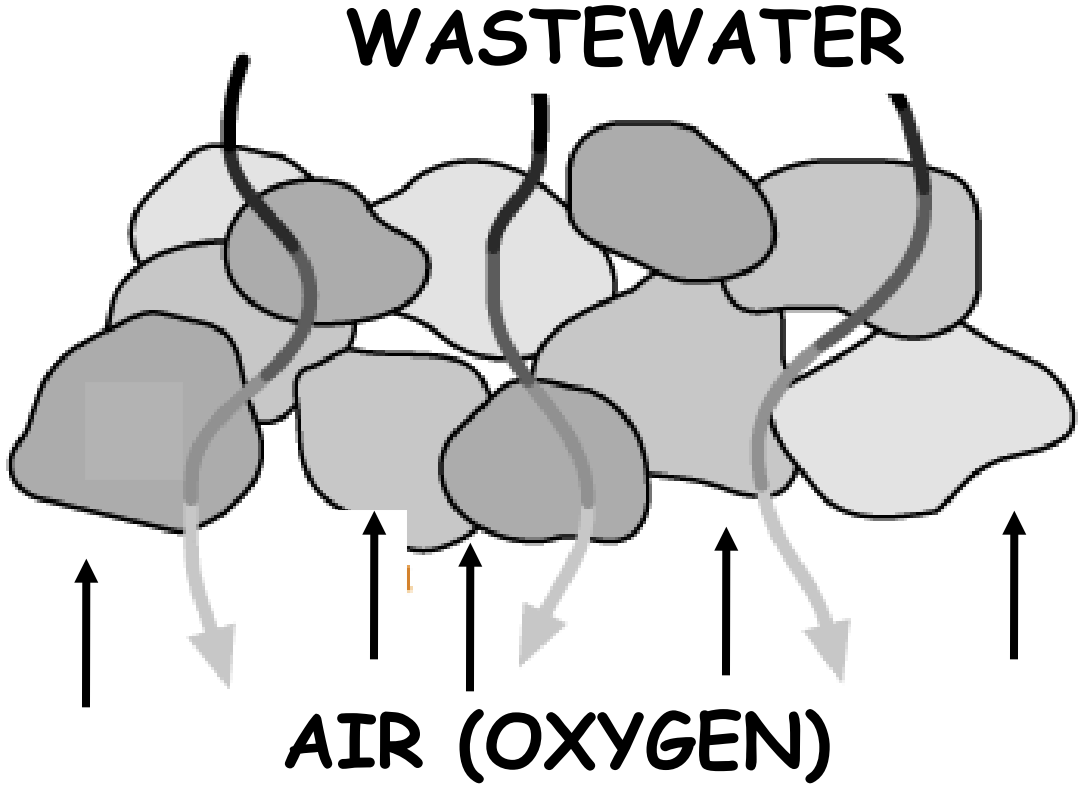
- INSECT LARVAE or <u>SNAILS</u>



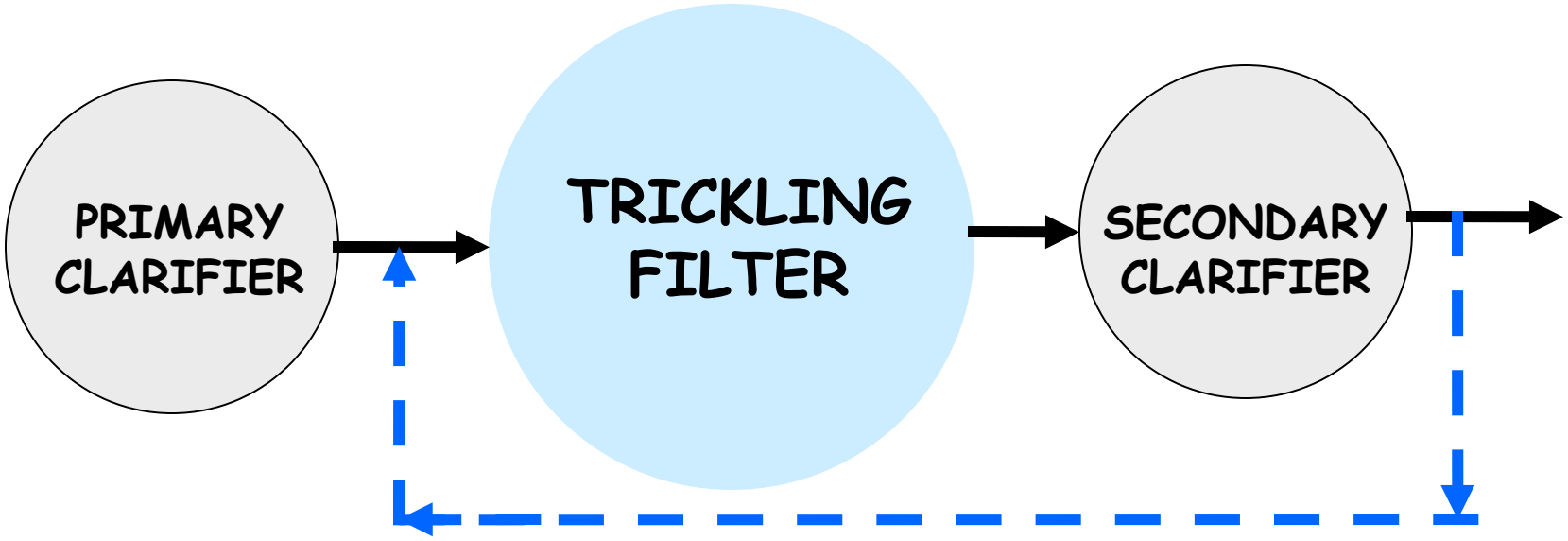
PROBLEM WITH PONDING

PONDING PREVENTS AIR CIRCULATION THAT IS VITAL TO MAINTAINING AN ACTIVE SLIME LAYER

POOR AIR CIRCULATION MEANS POOR BOD REMOVAL



RECIRCULATION



RECYCLING TREATED EFFLUENT

RICIRCULATION:

- MAY BE CONSTANT OR INTERMITTENT

- MAY BE ONLY DURING LOW FLOWS TO KEEP THE DISTRIBUTORS MOVING

- IMPROVES BOD REMOVAL BECAUSE OF LONGER CONTACT TIMES

RECIRCULATION…

- PRODUCES MORE CONTINUOUS AND UNIFORM SLOUGHING

  - WHICH PREVENTS PONDING AND IMPROVES VENTILATION

  - PRESENTS A MORE AGGRESSIVE SURFACE FOR NEW SLIME GROWTH

  - DECREASES THE PROBLEMS WITH PESTS—FILTER FLIES AND SNAILS

FLOW TO A TRICKLING FILTER IS GENERALLY REGULATED THRU A WET WELL or DOSING CHAMBER

TRICKLING FILTERS CAN SUCCESSFULLY TREAT ALMOST ANY WASTE—EXCEPT THOSE WITH HIGH CONCENTRATIONS OF…

- TOXIC WASTES
- PESTICIDES
- HEAVY METALS or EXTREME pH WASTES

FOR MAXIMUM EFFICIENCY, TRICKLING FILTERS SHOULD BE KEPT AEROBIC BY…

- A PROPERLY DESIGNED COLLECTION SYSTEM (i.e. good flow to prevent septic conditions)
- PROPER OPERATION OF THE PRIMARY CLARIFIERS
- PRETREATMENT WITH AIR OR RECYCLED FILTER EFFLUENT

TRICKLING FILTERS ARE ALSO AFFECTED BY:

- TEMPERATURE OF THE WASTEWATER - -

IN GENERAL, THE ORGANISMS INCREASE AS THE TEMPERATURE RISES

WOULD YOU EXPECT YOUR BEST BOD REMOVAL DURING WINTER OR SUMMER?

CLASSIFICATIONS OF TRICKLING FILTERS

BASED ON HYDRAULIC AND BOD LOADING…

HYDRAULIC LOADING:

GPD/SQ-FT

BOD LOADING:

Lbs BOD per day / 1000 cu-ft

CLASSIFICATIONS OF TRICKLING FILTERS

BASED ON HYDRAULIC AND BOD LOADING…

- STANDARD-RATE
- HIGH-RATE
- ROUGHING FILTERS

ROUGHING FILTER PRECEEDS SOME OTHER FORM OF SECONDARY TREATMENT (SUCH AS ACTIVATED SLUDGE)

STANDARD-RATE

PARAMETER	VALUE
• FLOW	25-100 gpd/sq-ft
• BOD	5-25 lbs BOD per day/ 1000 cu-ft
• % BOD removal	90-95 %

HIGH-RATE TRICKLING FILTER

PARAMETER	VALUE
• FLOW (ROCK)	100-1000 gpd/sq-ft
• FLOW (SYNTHETIC)	350-2100 "

HIGH-RATE TRICKLING FILTER

PARAMETER	VALUE
• BOD (rock)	25-100 lbs BOD per day/1000 cu-ft
• BOD (synthetic)	50-300
"	
• BOD removal	90 - 95 %

ROUGHING FILTER

PARAMETER	VALUE
• FLOW	(same as high-rate)
• BOD	100-300 lbs BOD per day/1000 cu-ft
• BOD removal	80 - 85 %

COMPARISON OF HYDRAULIC LOADINGS—gpd/sq-ft

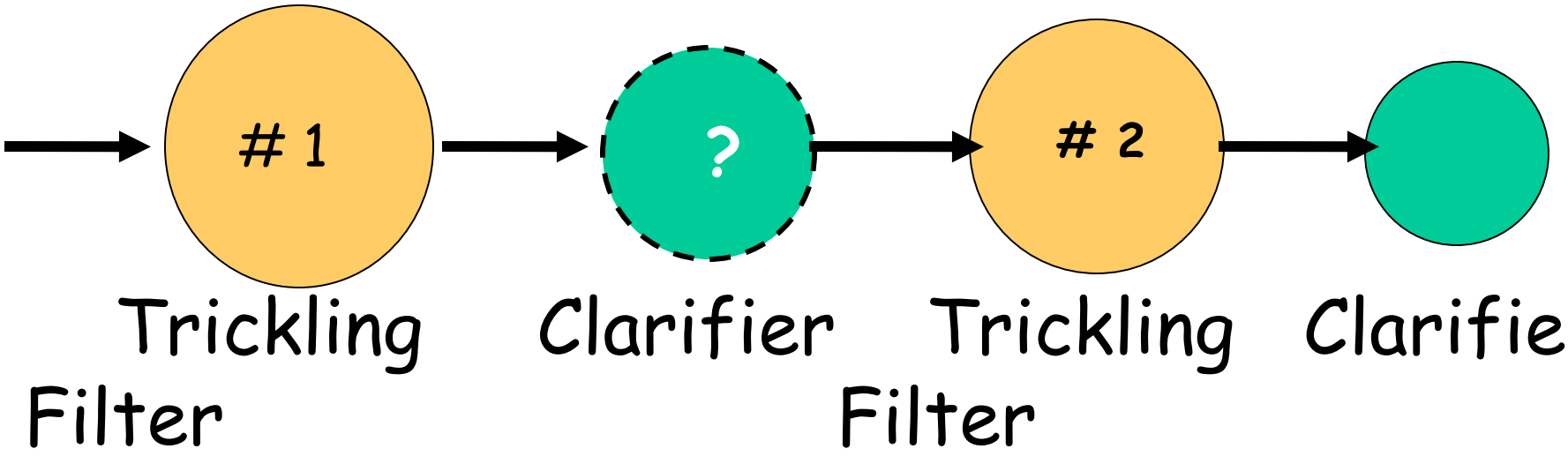
Standard Rate	25 to 100
High Rate (rock)	100 to 1000
(synthetic media)	350 to 2100
Roughing	100 to 2100

COMPARISON OF ORGANIC LOADING: lbs BOD per day/1000 cu-ft

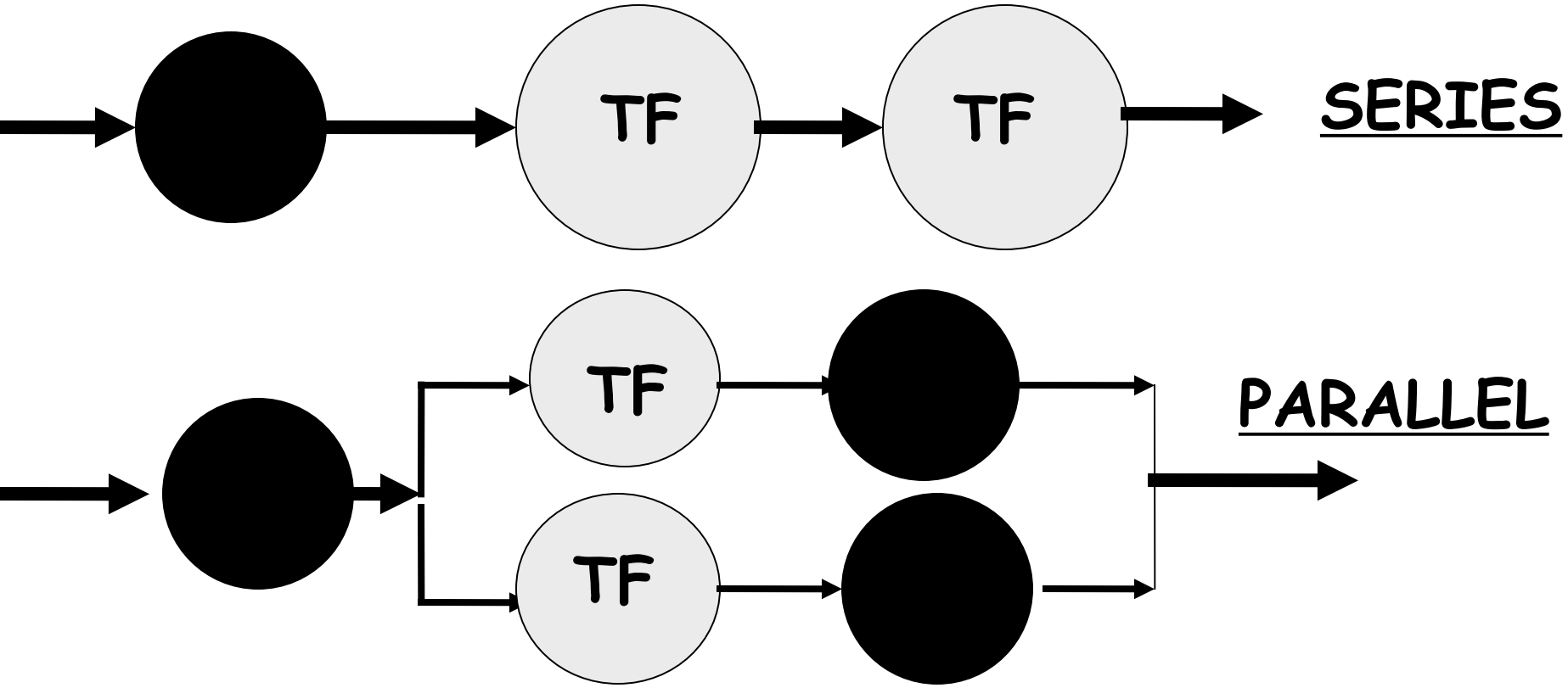
Standard Rate	5 to 25
High Rate (rock)	25 to 100
(synthetic)	50 to 300
Roughing	100 to 300

TWO-STAGE TRICKLING FILTER

(LOTS OF OPTIONS FOR RECIRCULATION)



TRICKLING FILTERS CAN BE OPERATED…



TRICKLING FILTER START-UP

BEST TO START-UP IN SPRING TO EARLY SUMMER.

TAKES SEVERAL WEEKS FOR GROWTH TO FULLY DEVELOP.

ROTATOR ARMS TURN ABOUT 1 RPM

NEVER STAND IN FRONT OF A TURNING ARM!

POOR FILTER PERFORMANCE

HIGH SUSPENDED SOLIDS:

- HEAVY SLOUGHING (weather changes)
- FLOW TOO HIGH?
- SOLIDS CARRY-OVER FROM CLARIFIERS (PRIMARY, SECONDARY, OR BOTH)
- SHOCK LOAD

DAILY OPERATION

- VERY LITTLE ROUTINE CONTROL NEEDED—VERY RELIABLE PROCESS

- CHECK FOR PONDING, FILTER FLIES, ODORS, PLUGGED ORIFICES, AND SEAL LEAKAGES

DAILY OPERATION (CON'T)

PONDING (LOSS OF OPEN AREA IN THE FILTER)

- CHECK PRIMARY CLARIFIER

- HIGH PRESSURE SPRAY ON ROCKS; HAND-TURN THE MEDIA; CHLORINATION; FILTER FLOODING; SHUT-DOWN AND LET DRY

DAILY OPERATION (CON'T)

RECIRCULATION

- USE MINIMUM RECIRCULATION (MEET NPDES LIMITS W/O PROBLEMS) THAT WILL PROVIDE DISSOLVED OXYGEN CONCENTRATIONS OF 3-6 mg/L (for rocks) and 4-8 mg/L (synthetic media)

ODOR CONTROL

- SHOULDN'T BE ODORS IF KEPT AEROBIC

- INCEASE RECIRCULATION RATE OR USE "MASKING AGENT"

FILTER FLIES

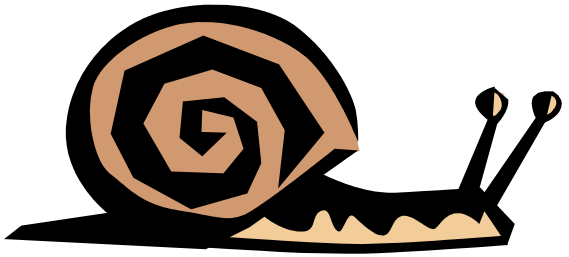
PSYCHODA (sigh-COAT-AH)

NON-BITING PESTS CONTROLLED BY:

- INCREASING RECIRCULATION
- FLOODING FILTERS FOR 24 hrs
- GOOD HOUSE-KEEPING (CUT WEEDS, SHRUBBERY, TALL GRASS)
- PESTICIDES (GROWTH REGULATORS)

ANOTHER PROBLEM PEST- -

SNAILS




SNAIL
REMOVAL

UNCONTROLLED SLOUGHING

ONE OF THE MOST COMMON PROBLEMS GENERALLY SOLVED BY INCREASING RECIRCULATION

COLD WEATHER PROBLEMS

- SOMETIMES FREEZING OCCURS NEAR THE DISTRIBUTOR NOZZLES

- CUT BACK ON RECIRCULATION (RECIRCULATED WATER IS GENERALLY COLDER THAN THAT FROM THE PRIMARY CLARIFIER)

- GO FROM A SERIES TO A PARALLEL OPERATION

IN EXTREME COLD WEATHER…

MIGHT HAVE TO ENCLOSE TRICKLING FILTERS

VENTILATION

NEED A TEMPERATURE DIFFERENCE OF AT LEAST 3°F BETWEEN THE AIR AND THE WATER THROUGH THE FILTER TO GET GOOD NATURAL CIRCULATION

PLANT INFLOW VARIATIONS
(DUE TO STORMS, INFLITRATION, OR INDUSTRIAL DISCHARGES)

3 OPTIONS:

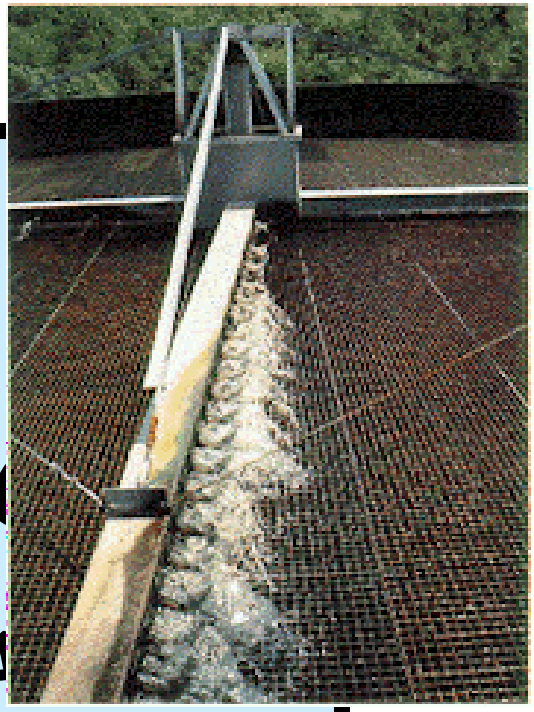
- VARY THE NUMBER OF FILTERS ON LINE
- ADJUST THE RECIRCULATION RATE
- SWITCH FROM SERIES TO PARALLEL (OR VISA-VERSA)

MAINTENANCE

- SEALS: OLD UNITS HAD MERCURY SEALS. NEW UNITS HAVE OIL-BATH SEALS THAT SHOULD BE CHECKED WEEKLY

- CHECK OIL FOR CLEANLINESS AND REPLACE WHEN DIRTY

MAINTENANCE



DISTRIBUTOR ARMS:

- FLUSH ARMS <u>WEEKLY</u> BY OPENING THE END FLUSH (

- <u>SPEED</u> OF THE ROTATOR A IS GOVERNED BY FLOW FROM THE ORFICES

UNDERDRAIN MAINTENANCE

BEST WAY TO CLEAN IS TO USE CITY'S HIGH VELOCITY SEWER LINE CLEANER EVERY 6 MO.

TRICKLING FILTER CLARIFIER

- HUMUS IS HIGH IN BOD AND MUST BE REMOVED

- EXPECT TO PUMP 30-40% MORE SLUDGE FROM A SECONDARY CLARIFIER (THAN A PRIMARY CLARIFIER)