

PRELIMINARY TREATMENT

(aka PRETREATMENT)

WE WILL DISCUSS THE HEADWORKS:

- **WET WELL (PUMPS)**
- **SCREENS**
- **SHREDDERS**
- **GRIT REMOVAL**



**MOST TREATMENT
PLANTS ARE BUILT
DOWN-GRADIENT
FROM THE AREA
SERVED**

WWTP

**SAVES \$ TO MAKE USE OF “NATURAL”
FORCES—GRAVITY, SUNLIGHT, WIND
BIOLOGICAL ACTIVITY**

PROBLEMS WITH LOCATIONS

- **“AIRPORT SYNDROME”**

- **“ENVIRONMENTAL RACISM”**

**SOMETIMES, PLANTS HAVE TO
BE LOCATED “UP-GRADIENT...**

- LAND AVAILABILITY
- HIGH GROUND WATER TABLE

MIGHT REQUIRE LOW-LIFT PUMPS

PUMPS

**REQUIREMENTS FOR A GOOD
PUMP ARE:**

- **HANDLES VARIABLE FLOW**

- **MUST HANDLE DEBRIS**

- **FEWER MOVING PARTS—
THE BETTER**

SCREW PUMPS





**ARCHIMEDES
INVENTED THE
SCREW PUMP**

**ALSO KNOWN AS THE
“ARCHIMEDES SCREW”**

ARCHIMEDES MORE FAMOUS FOR HIS “LAW OF BUOYANCY”

ALSO INVENTED / DEVELOPED:

- CATAPULTS**
- BURNING MIRRORS**
- LEVER THEORY**

**SCREW PUMPS
WERE USED TO
DRAIN THE
ZEIDER ZEE AND
RECLAIM THE
POLDERS IN THE
NETHERLANDS**



SCREW PUMPS

USED FOR:

- RAW AND TREATED SEWAGE
LIFT STATIONS
- ACTIVATED SLUDGE RETURN
- STORM WATER PUMPING
- LAND DRAINAGE/INDUSTRIAL
WASTE

SCREW PUMPS

- **AVAILABLE FROM 1-FOOT TO 12 FEET DIAMETER**

- **HANDLES FLOWS FROM:
100 to 95,000 GAL/MIN**

- **LIFTS FROM 6 to 40 FEET**



CLOSED SCREW PUMP

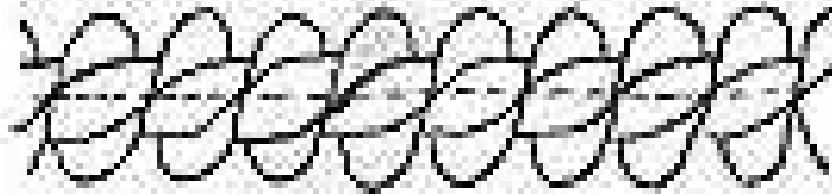


OPEN SCREW PUMP

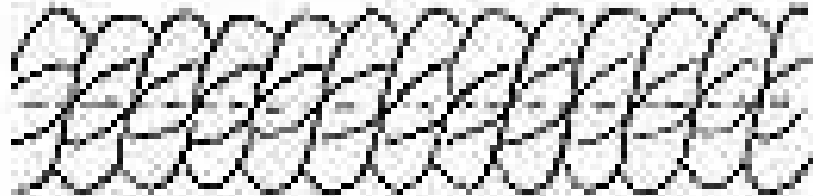
ONE
FLIGHT



TWO
FLIGHT



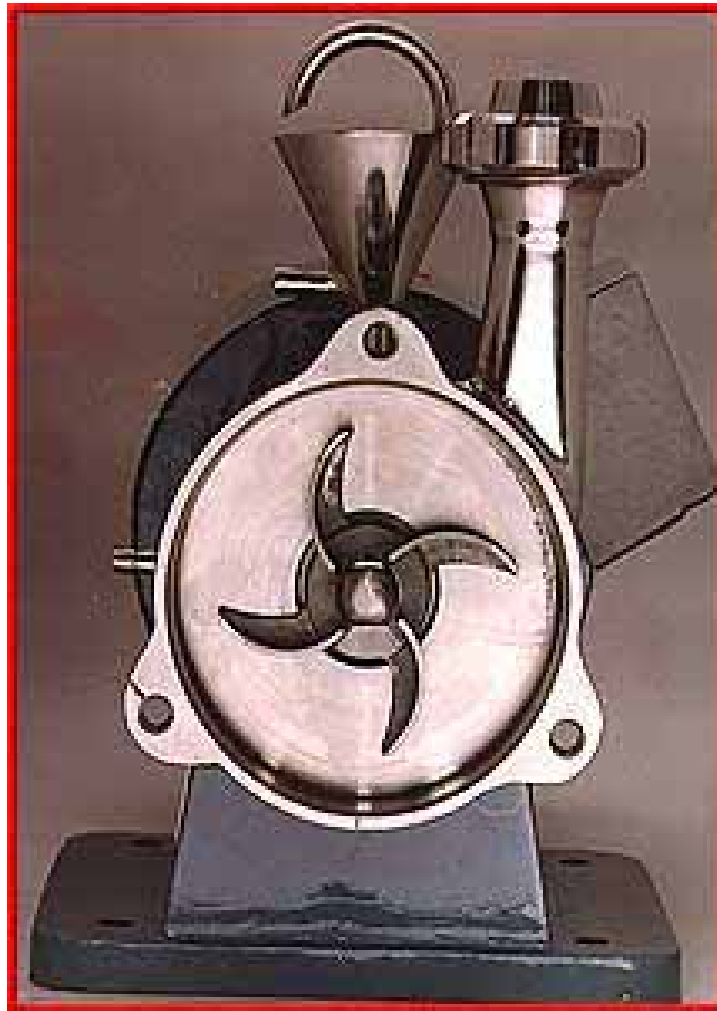
THREE
FLIGHT



**FLIGHTS (or HELIXES) ON A
SCREW PUMP**

OTHER WASTEWATER PUMPS

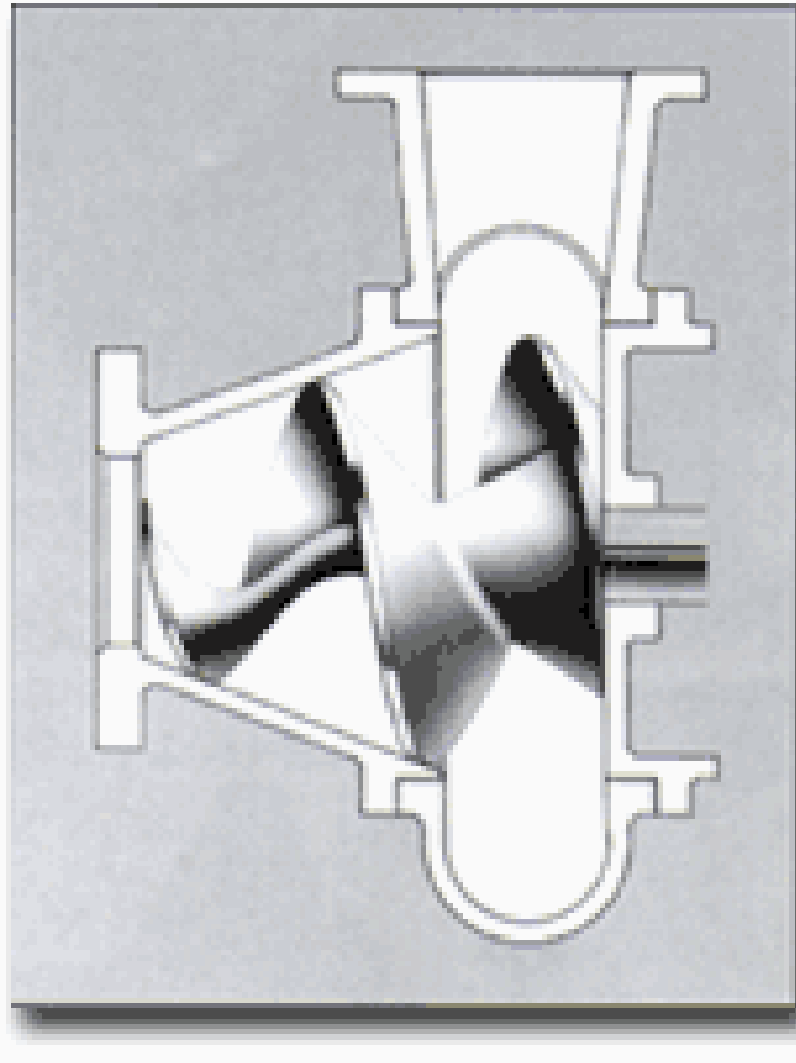
- **GEAR PUMPS**
- **ROTARY PUMPS**
- **RECIPROCATING PUMPS**
- **CENTRIFUGAL PUMP
(CLOSEST COMPETITOR FOR
THE SCREW PUMP)**



CENTRIFUGAL PUMP

CENTRIFUGAL vs SCREW PUMPS

	<u>CP</u>	<u>SP</u>
MUST PRE-SCREEN	<u>YES</u>	NO
DEEP WET WELL	<u>YES</u>	NO
HIGH MAINTENANCE	<u>YES</u>	NO
INEFFICIENT	YES	NO
USE W / ACT. SLUDGE	NO	YES
LIMITED LIFT	NO	YES



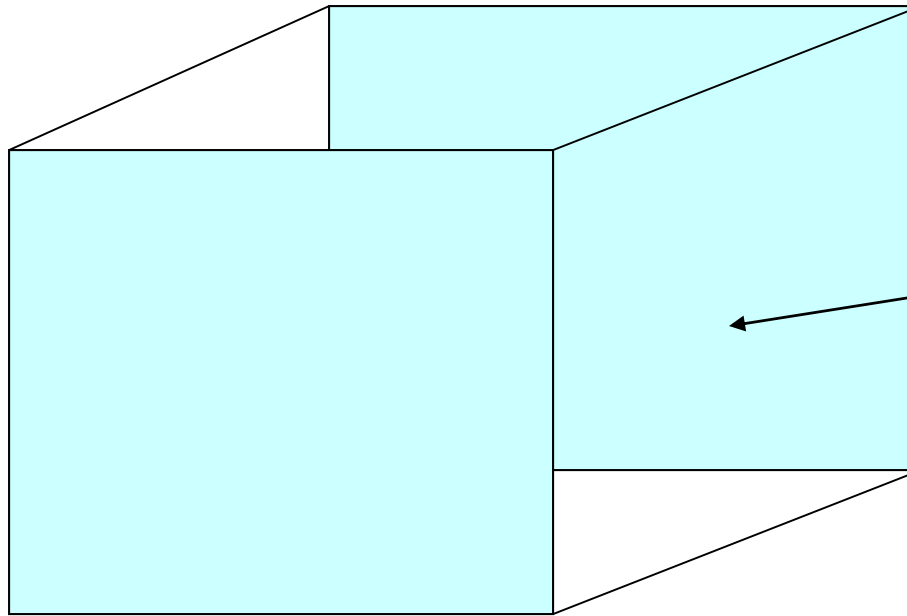
CENTRIFUGAL SCREW PUMP

“HEAD” and “HEAD LOSS”

**“HEAD” REFERS TO FLUID
PRESSURE or ENERGY**

**“HEAD LOSS” REFERS TO
ENERGY or FRICTION LOSS**

**BOTH ARE EXPRESSED IN INCHES
or FEET of WATER**



**One
cubic
foot of
water**

WEIGHS 62.4 POUNDS

**ONE FOOT OF “HEAD” IS
EQUIVALENT TO 0.43 pounds/sq in**

**ONE FOOT OF “HEAD
LOSS” WOULD BE THE
SAME AS:**

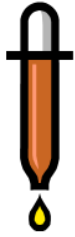
- 0.43 psi

PRELIMINARY TREATMENT

(aka PRETREATMENT)

- SCREENING: TO REMOVE
LARGE DEBRIS

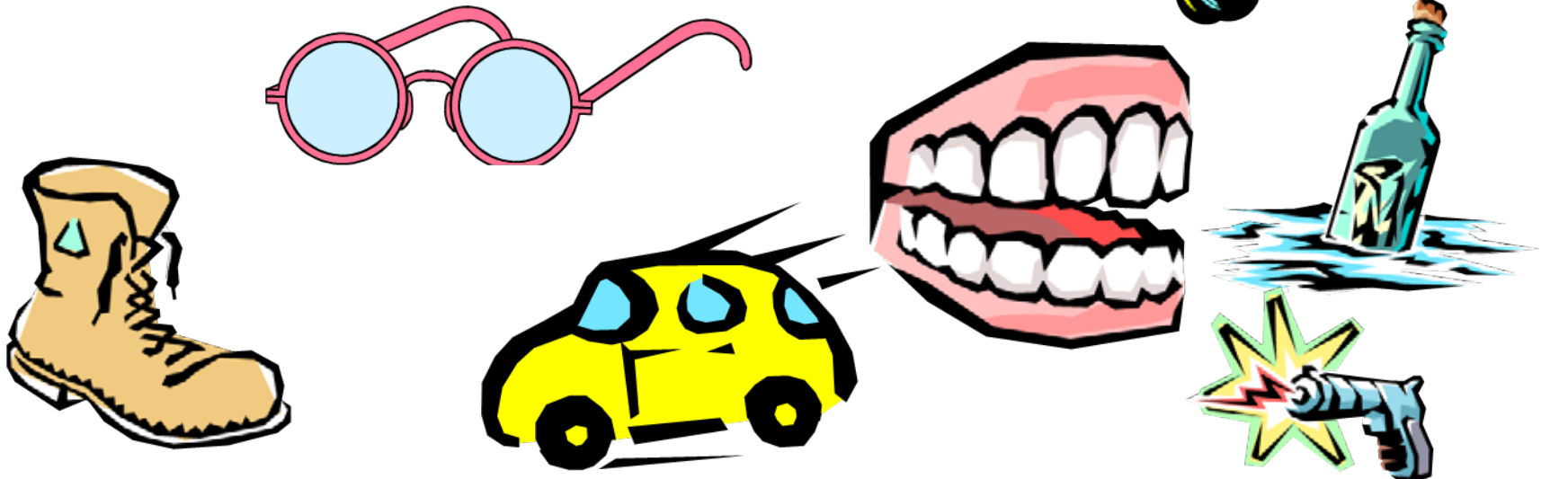
- **RACKS and BAR SCREENS**



SCREENING



**PURPOSE: TO REMOVE LARGE,
NON-BIODEGRADABLE ITEM
FROM SEWAGE SUCH AS..**



RACKS

- BAR SPACING 3 to 4 INCHES

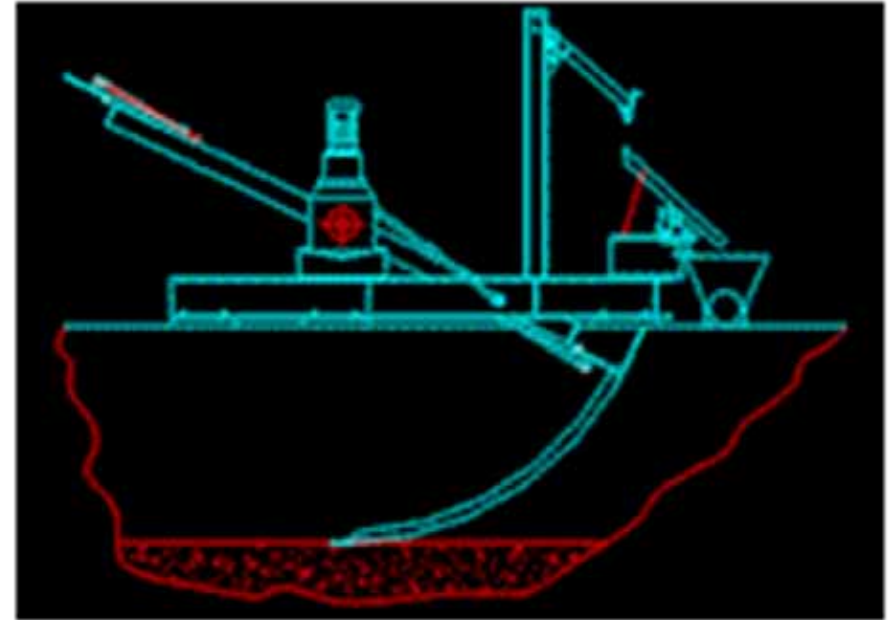
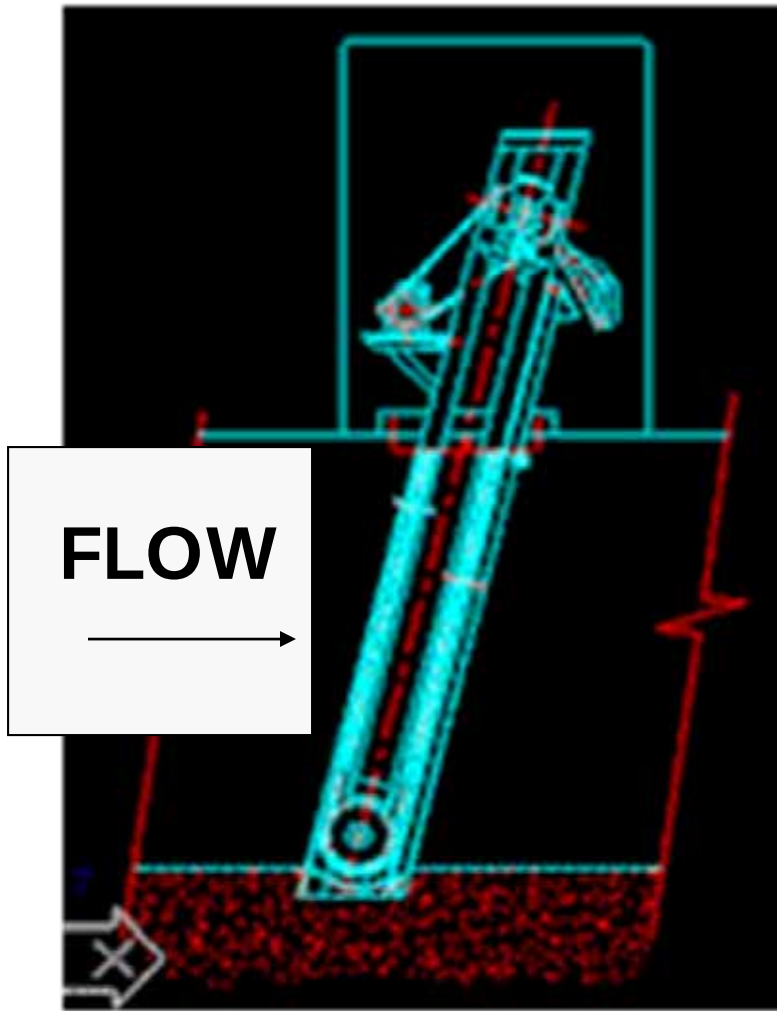
- INCLINED UP TO 45 DEGREES

- USUALLY MANUALLY CLEANED

BAR SCREENS

- **BAR SPACING 3/8 to 2 INCHES**

- **OFTEN MECHANICALLY CLEANED**

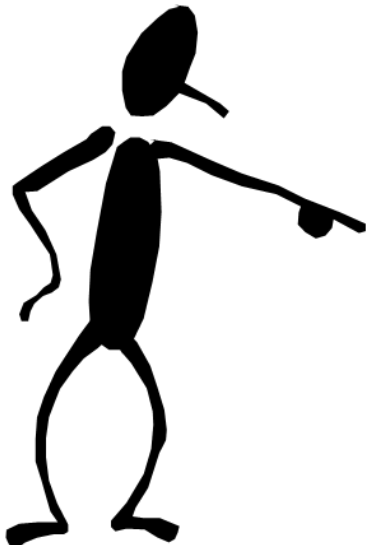


INCLINED & RADIAL BAR SCREENS

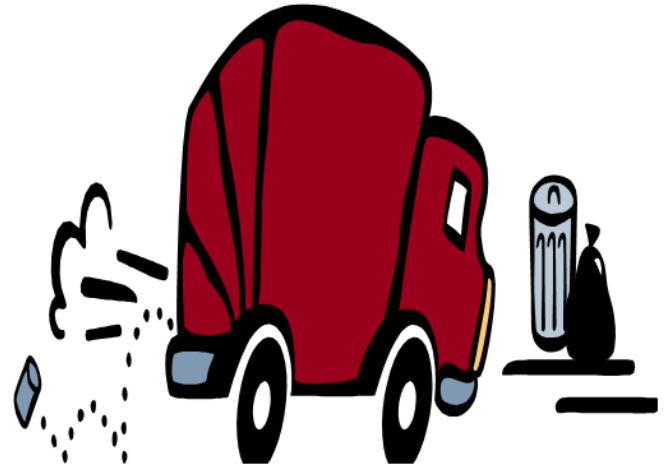
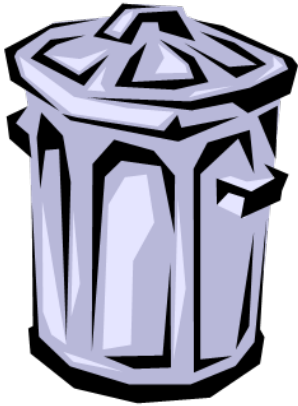


**SAFETY AND MAINTENANCE
AROUND THE RACKS &
SCREENS**

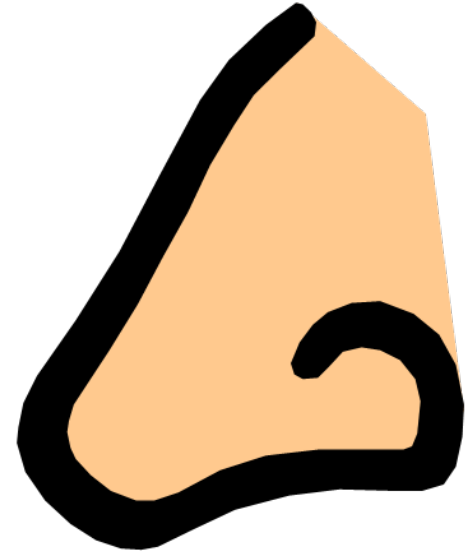
**TURN OFF AND LOCK-OUT
ANY ELECTRICAL
EQUIPMENT BEFORE YOU
WORK ON THEM!**



**KEEP THE SCREENS
CLEAN TO REDUCE HEAD
LOSS (AND COSTS)**



DISPOSAL OF SCREENINGS



**SCREENINGS “STINK” AND MAY
BE HAZARDOUS**

**DISPOSE OF BY BURIAL OR
INCINERATION**



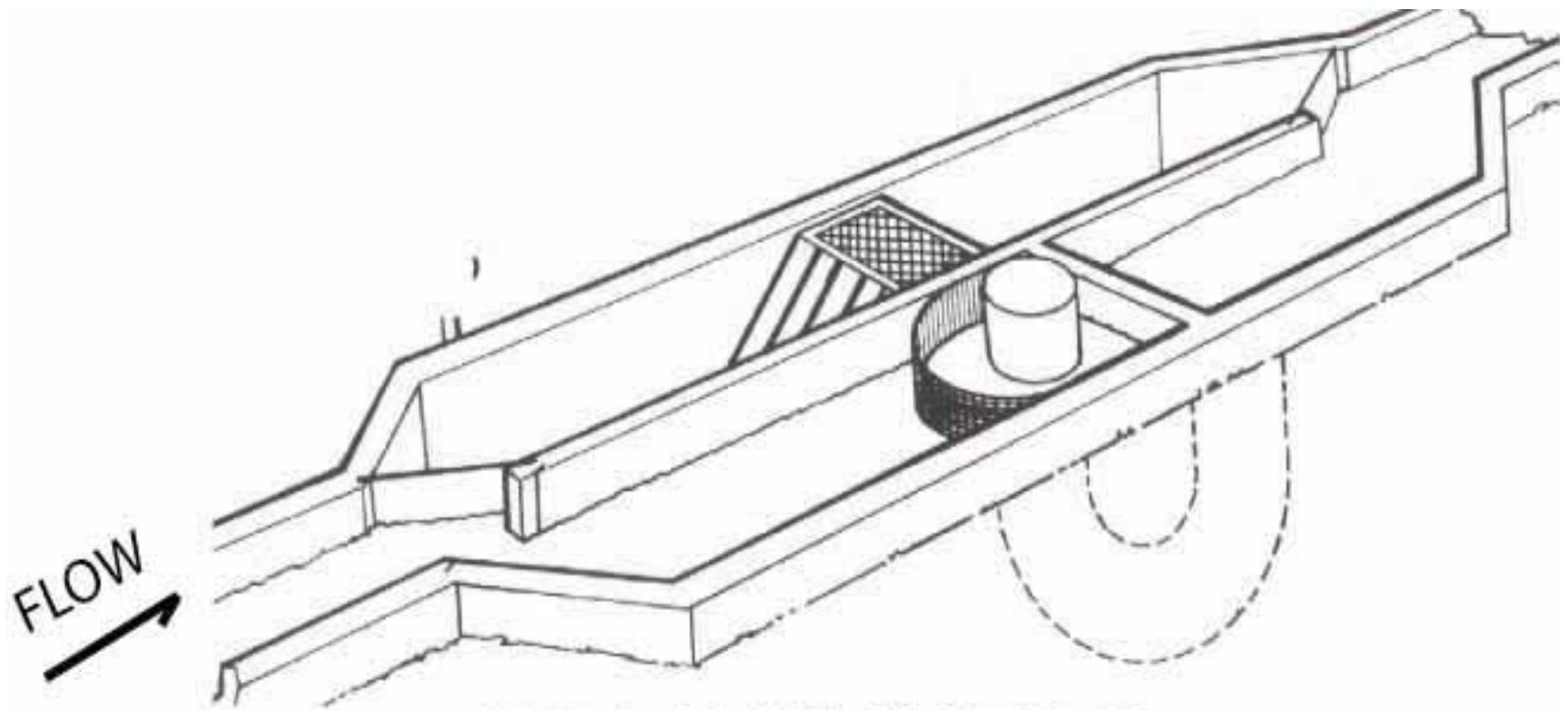
- BURY WITH AT LEAST 6 INCHES OF COVER- - TO DISCOURAGE VECTORS

- NO ADVERSE AFFECTS ON GROUND OR SURFACE WATERS

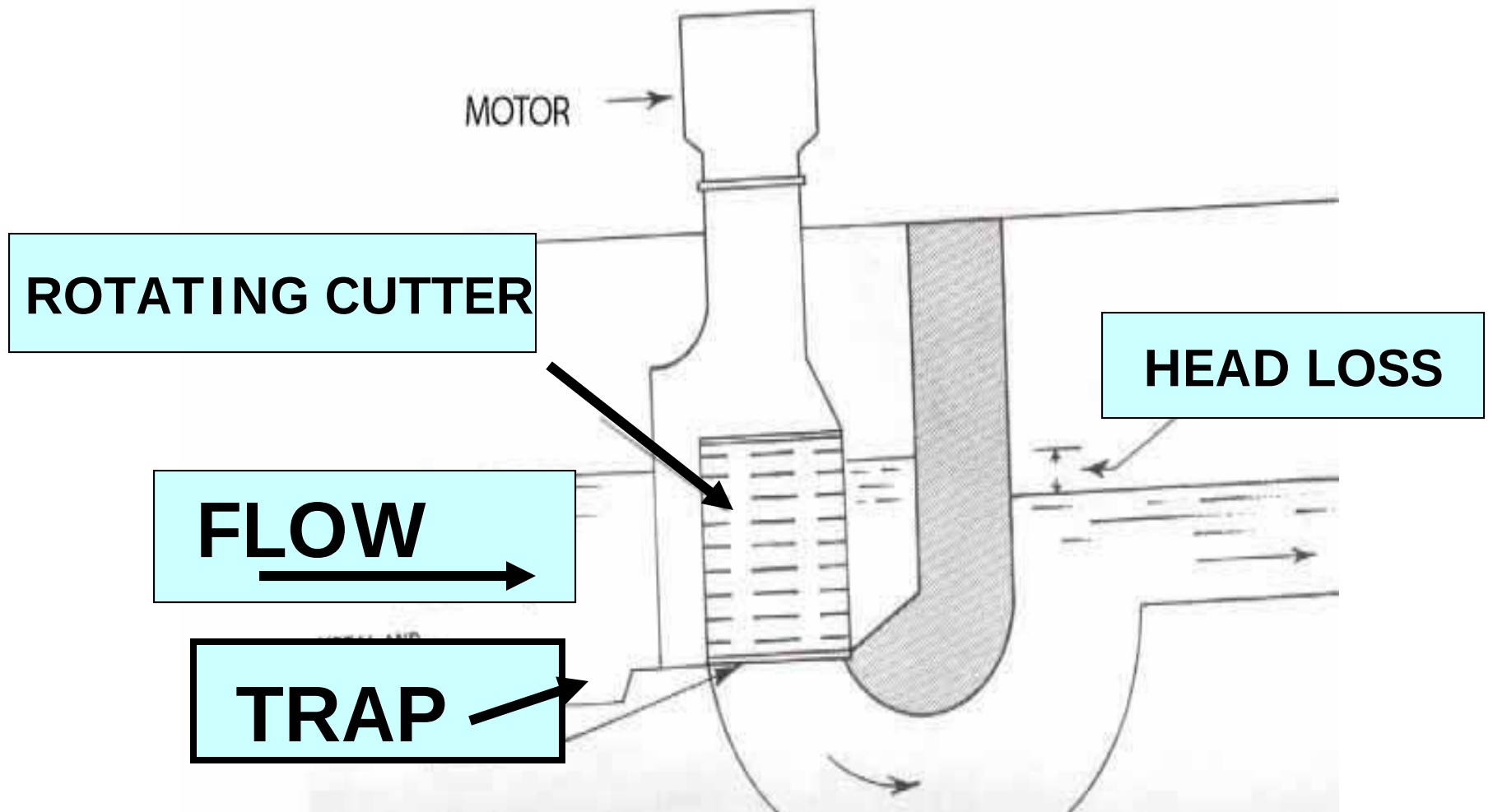
COMMINUTION (SHREDDING)

SOMETIMES...

- **USED IN LIEU OF BAR SCREENS**
- **FOLLOW BAR SCREENS**
- **FOLLOW GRIT CHAMBER**



COMMINUTOR



COMMINUTOR

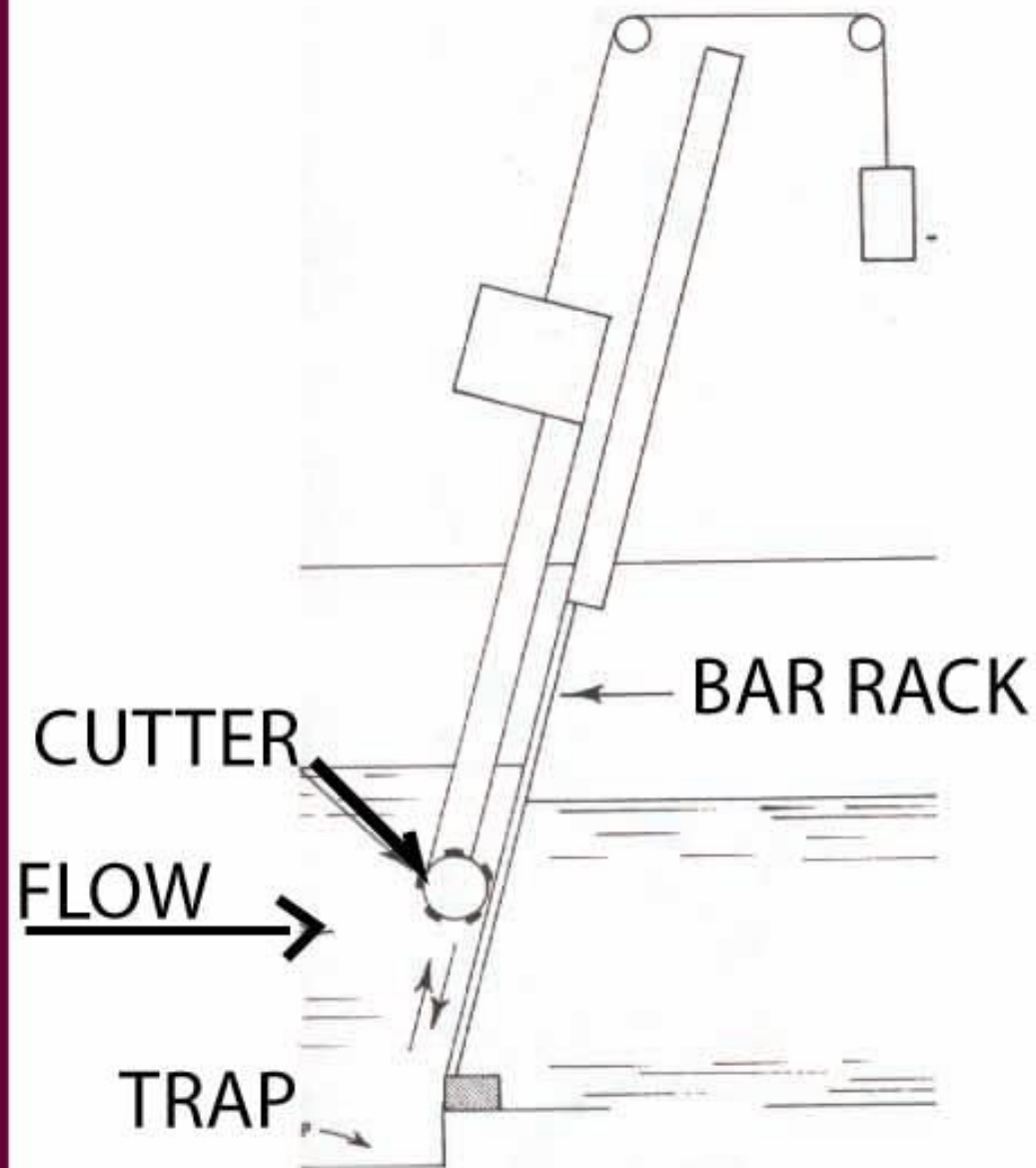
NOTE!!!

**WATCH OUT FOR MERCURY
SEALS ON OLD UNITS.**

**MERCURY (Hg) IS VERY
DANGEROUS- - DO NOT
BREATHE!**



**MERCURY WAS USED IN
MANUFACTURING HATS.
REMEMBER THE “MAD HATTER”
FROM ALICE IN WONDERLAND ?**



BARMINUTOR (SIDE VIEW)

NEWER TYPES OF SHREDDERS



BAR SCREEN MONSTER®

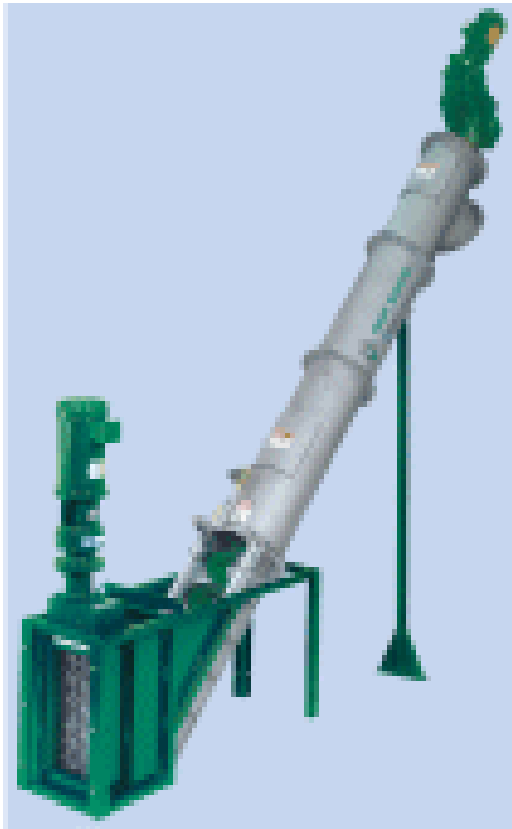
NEWER TYPES OF SHREDDERS



MUFFIN MONSTER®

**WIDELY USED IN
PRISONS TO PREVENT
SEWER BACKUPS**

NEWER TYPES OF SHREDDERS



AUGER MONSTER®

**OTHERS INCLUDE:
Mini Monster;
Macho Monster,
Channel Monster**

NEWER TYPES OF SHREDDERS

DIMMINUTOR®



NEWER TYPES OF SHREDDERS



CHOPPER PUMP

GRIT REMOVAL

RECALL:

**“GRIT” IS HEAVY INORGANIC
MATERIAL SUCH AS SAND, EGG
SHELLS, CINDERS**

**“GRIT”, WHEN MIXED
WITH GREASE, TAR AND
OTHER CEMENTING
MATERIALS...**

- **WILL CAUSE EXCESSIVE WEAR
ON PUMPS**

- **WILL CLOG PIPES and SUMPS**

**GRIT + OIL + GREASE =
DETRITUS**

**IN SOME AREAS, GRIT
CHAMBERS (or
CHANNELS) ARE CALLED
“DETRITUS TANKS”**

TYPES OF GRIT CHAMBERS

1) HORIZONTAL FLOW

2) AERATED

3) VORTEX (cyclone separator)

HORIZONTAL GRIT CHAMBER

- **OLDEST TYPE AND
MOST COMMON**

- **EXPERIENCE HAS SHOWN A
VELOCITY AROUND 1 ft /sec IS
BEST FOR GRIT REMOVAL**

**MAINTAINING A CONSTANT
FLOW THROUGH THE CHAMBER**

**BECAUSE INFLUENT QUANTITIES
VARY, YOU MUST:**

- **VARY THE NUMBER OF CHAMBERS
ON LINE**
- **USE A PROPORTIONAL (aka SUTRO)
WEIR AT THE OUTLET OF THE CHAMBER**

WHAT'S A PROPORTIONAL WEIR?

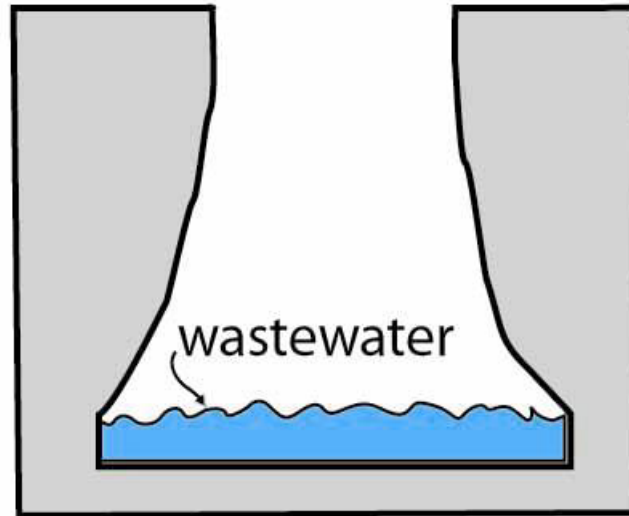
**A SPECIALLY DESIGNED
CONSTRICTION TO GO IN THE
EFFLUENT END OF A GRIT
CHAMBER**

**FLOW THROUGH THE WEIR IS
PROPORTIONAL TO THE HEIGHT OF
THE WATER IN THE CHANNEL**

HOW A PROPORTIONAL WEIR WORKS:

$$Q = \underline{V} \times \underline{A}$$

WHERE: Q IS
THE FLOW;
 V IS THE
VELOCITY, AND
 A IS THE
CROSS-
SECTIONAL
AREA



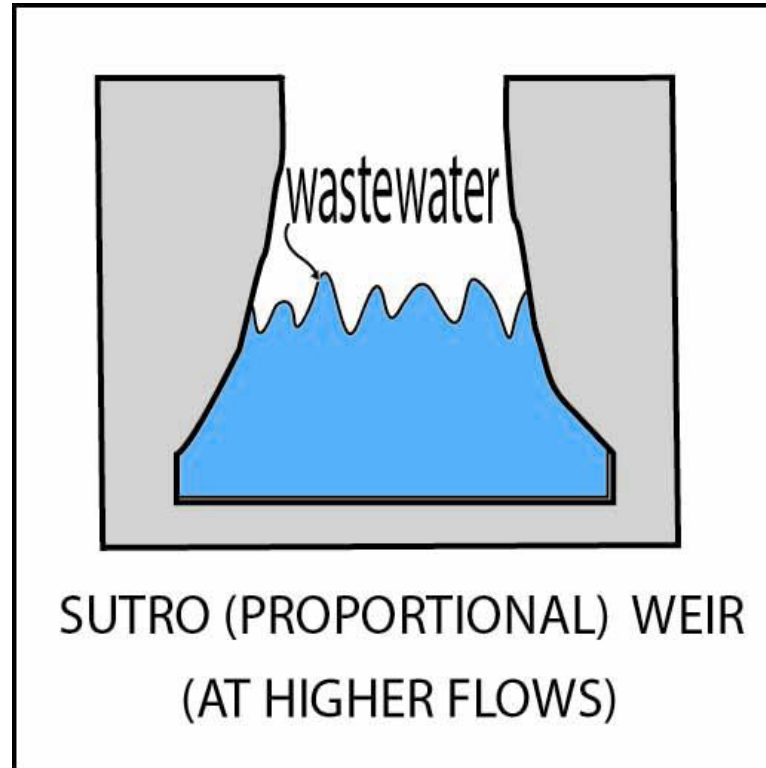
SUTRO (PROPORTIONAL) WEIR
(AT LOW FLOWS)

VELOCITY = 1 FPS

HOW A PROPORTIONAL WEIR WORKS:

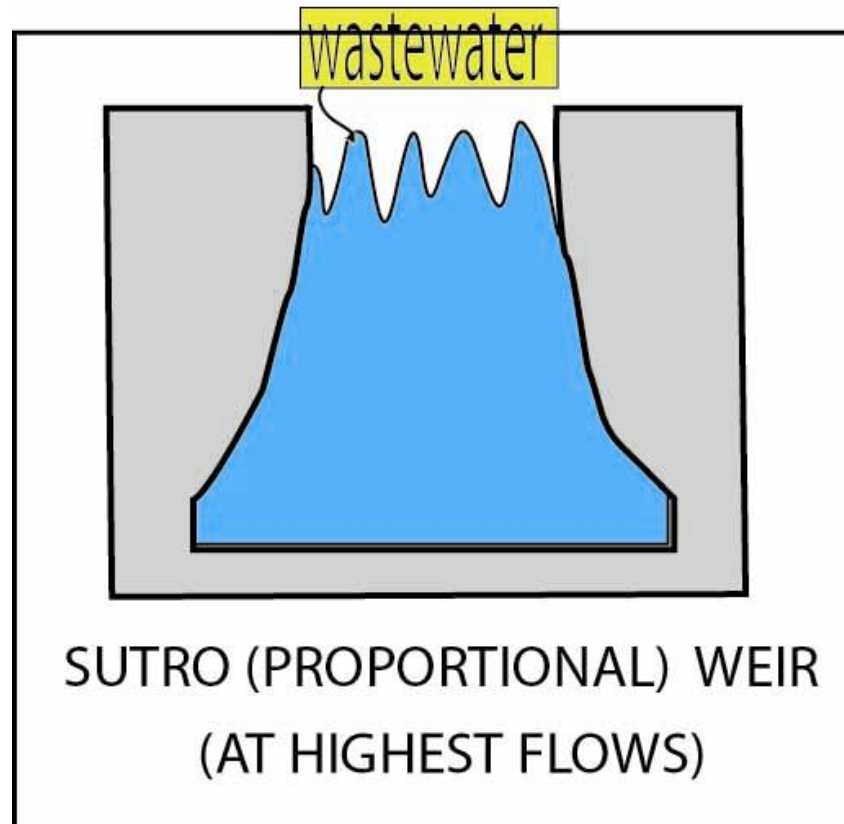
$$V = Q / A$$

AS Q
INCREASES,
 A MUST
DECREASE
FOR V TO
REMAIN AT
1 FPS.



VELOCITY = 1 FPS

HOW A PROPORTIONAL WEIR WORKS:



VELOCITY remains = 1 FPS

HOW TO MEASURE VELOCITY IN A GRIT CHAMBER

**ONE EASY WAY IS TO DROP
IN SOMETHING THAT
FLOATS AND TIME IT OVER
A MEASURED DISTANCE**

GRIT CHAMBER VELOCITY

**EXAMPLE: YOU DROP IN
A STICK AND IT TAKES
20 SECONDS TO FLOAT
25 FEET.**

$$\text{VELOCITY} = 25 \text{ FT} / 20 \text{ SEC} = \underline{1.25} \text{ fps}$$

PARTICLE REMOVAL in a grit chamber

- **DESIGNED TO REMOVE
0.2 mm SAND PARTICLES**
- **0.2 mm SAND SETTLES AT
22 mm/sec (0.075 ft/sec)**
- **About 13 sec for a particle to
settle 1 ft (1 ft / 0.075 ft/sec
= 13.3 sec)**

SHORT CIRCUITING AND “DEAD” SPOTS IN TANKS

**NO TANK IS PERFECT WHEN IT
COMES TO FLOW**

**DEAD SPOTS (LITTLE or NO FLOW)
DEVELOP WHERE ORGANICS
CAN SETTLE OUT**

DEAD SPOTS CAUSE PROBLEMS

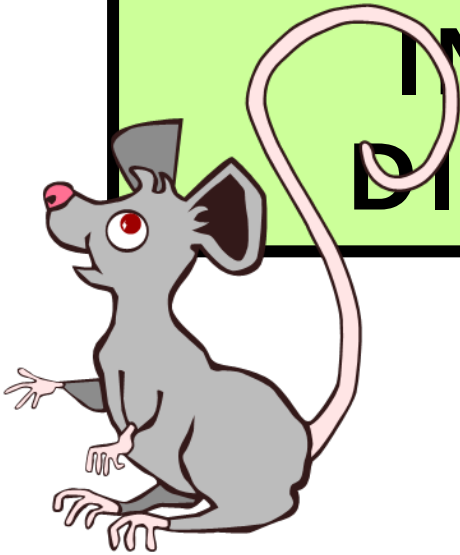
**ORGANICS BEGIN SETTLING
AND BECOME “PUTRESCIBLE”**

**SOMETIMES DEFLECTORS CAN
BE PLACED IN THE GRIT
CHAMBER TO MINIMIZE DEAD
SPOTS**

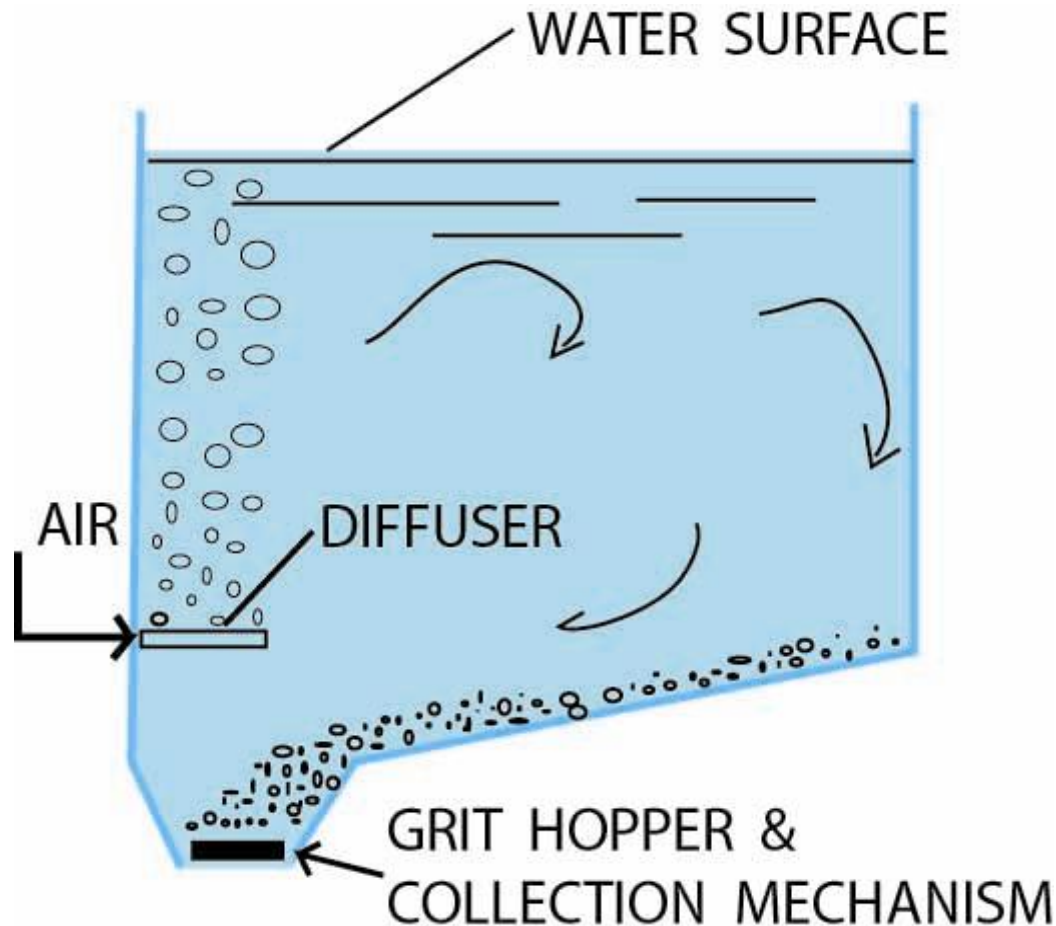
GRIT DISPOSAL

- **SHOULD BE REMOVED DAILY**

- **BURIED WITH AT LEAST 6
INCHES OF COVER TO
DISCOURAGE VECTORS**



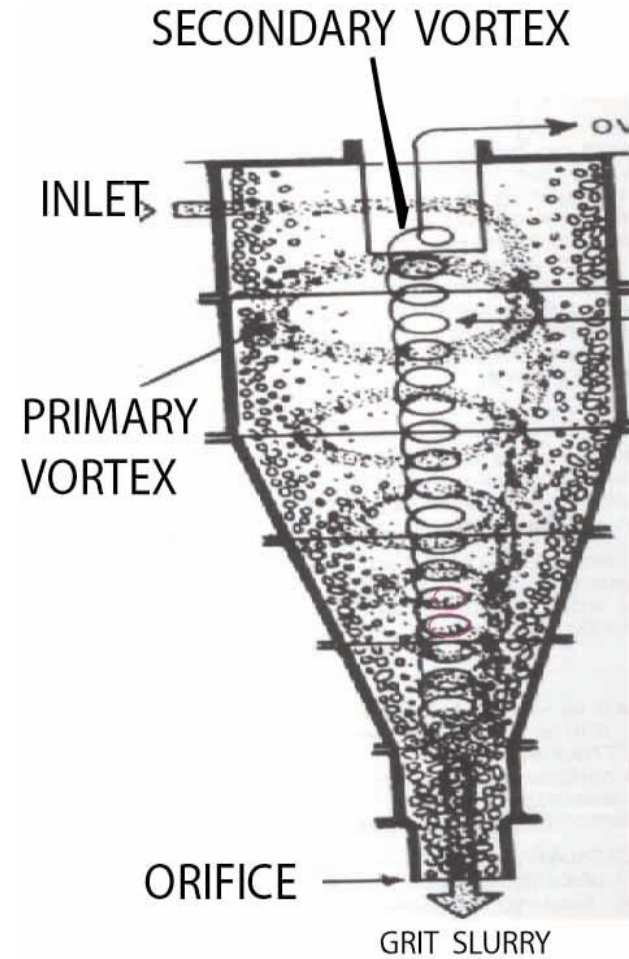
AERATED GRIT CHAMBER



AIR/WATER MIXTURE HAS LOWER SPECIFIC GRAVITY THAN WATER ALONE- GRIT SETTLES

VORTEX (CYCLONE) GRIT SEPARATOR

**CENTRIFUGAL
FORCE MOVES
HEAVIER
PARTICLES TO
OUTSIDE WALL**



VORTEX (CYCLONE) SEPARATOR