

NOTES FOR CVEN 4830/4434

BIOLOGICAL WASTEWATER TREATMENT PROCESSES

TRANSFORMATION OF ORGANIC MATTER IN SEWAGE:

AEROBIC PROCESS

ORGANIC MATTER + OXYGEN → CELLS + MINERAL PRODUCTS*

*CARBON DIOXIDE, WATER, SOLUBLIZED CELL MINERALS (N, P,...)

THIS PROCESS OCCURS IN THE NATURAL ENVIRONMENT WITH BACTERIA CATALYZING THE OXIDATION OF ORGANIC CARBON AND CONSUMING OXYGEN

2 ISSUES:

- NATURAL DIFFUSION WILL NOT SUPPLY ENOUGH OXYGEN
- NORMAL BACTERIAL GROWTH ON TYPICAL SEWAGE ORGANIC MATTER WILL NOT SUSTAIN ENOUGH GROWTH FOR A RAPID PROCESS

SO, IN THE **REACTION** PART OF A WASTEWATER TREATMENT PROCESS WHERE ORGANIC MATTER IS CONVERTED EITHER TO CELLS OR HARMLESS MINERAL END-PRODUCTS:

- OXYGEN IS SUPPLIED IN THE TREATMENT UNITS BY MECHANICAL AERATION (BLOWERS AND DIFFUSERS OR TURBINES)
- A HIGH DENSITY BACTERIA POPULATION IS MAINTAINED IN THE TREATMENT UNITS EITHER BY GROWING CELLS THAT ADHERE TO POROUS INERT MEDIA (ROCK, PLASTIC), **BIOFILM PROCESSES**, OR RECYCLING SUSPENDED CELLS, **ACTIVATED SLUDGE PROCESSES** (INCLUDING MEMBRANE BIOREACTORS).

BOTH BIOFILM AND ACTIVATED SLUDGE REQUIRE SEPARATION OF THE CELLS (AND ANY OTHER PARTICULATES) BEFORE DISCHARGE INTO A RECEIVING WATER. THIS FINAL SETTLING PROCESS OCCURS IN THE **SECONDARY CLARIFIER**.

- MOST COMMON SEPARATION IS GRAVITY SETTLING
- CAN USE MEMBRANE SEPARATION ALSO

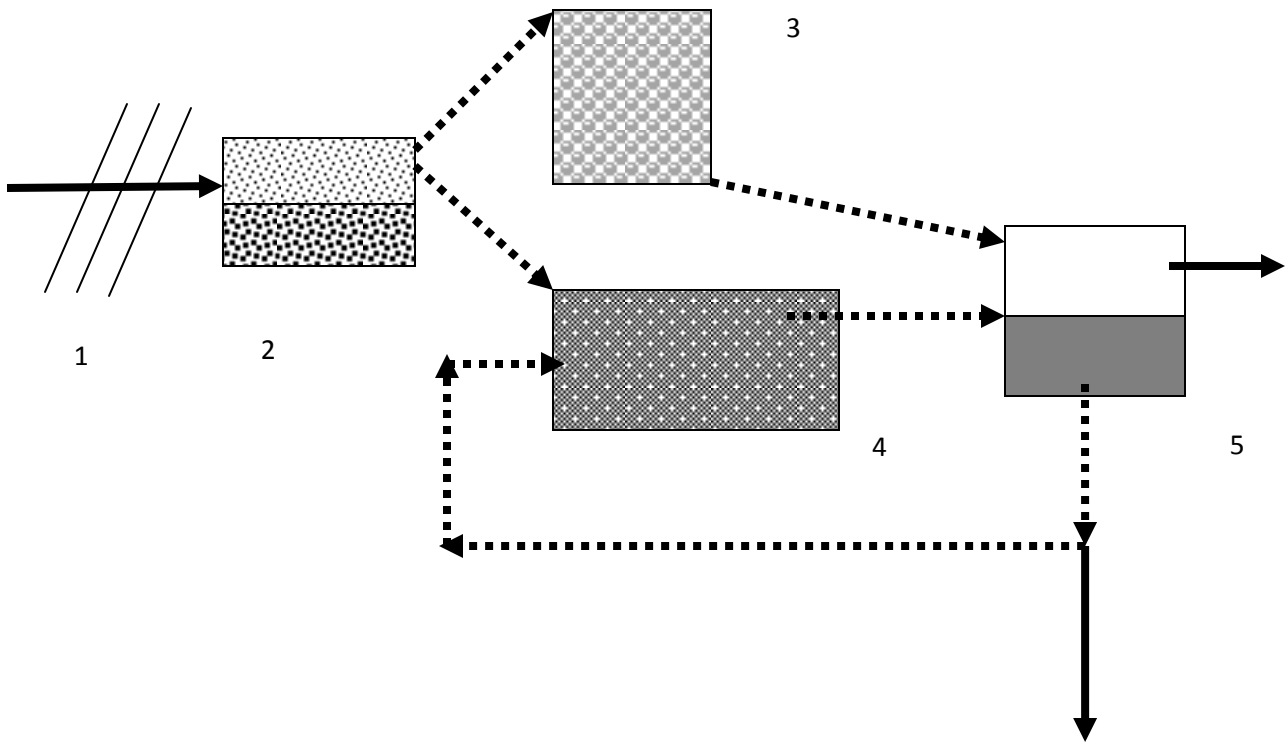
IN BIOFILM PROCESSES, CELLS FROM THE SETTLER ARE PUMPED OUT OF THE SETTLER, THICKENED, STABILIZED, DEWATERED AND DISPOSED OFF-SITE

IN ACTIVATED SLUDGE PROCESSES, A PORTION OF THE SETTLED CELLS ARE RECYCLED TO THE REACTION UNIT PROCESS AND A PORTION ARE PUMPED OUT, THICKENED, STABILIZED, DEWATERED AND DISPOSED OFF-SITE.

WASTEWATER ALSO CONTAINS PARTICULATE ORGANIC AND INORGANIC MATTER.

LARGE PARTICLES ARE REMOVED BY **SCREENS** TO PROTECT DOWNSTREAM HYDRAULIC EQUIPMENT (PUMPS, MIXERS, ETC). SCREENINGS ARE MECHANICALLY DEWATERED AND TAKEN TO A LANDFILL.

SMALLER PARTICLES ARE OFTEN REMOVED IN A GRAVITY SETTLING BASIN BEFORE THE WASTEWATER ENTERS THE BIOLOGICAL TREATMENT PROCESS UNIT (BIOFILM OR ACTIVATED SLUDGE). SMALLER PLANTS MAY NOT HAVE A PRIMARY CLARIFIER, BUT LARGER PLANTS, LIKE THE BOULDER WASTEWATER TREATMENT PLANT (BWWTP) DO. **PRIMARY CLARIFIERS** TYPICALLY REMOVE APPROXIMATELY 50 – 60% OF THE INFLUENT PARTICULATE MATTER. THE SETTLED PRIMARY “SLUDGE” IS PUMPED FROM THE BOTTOM OF THE CLARIFIER AND MIXED WITH THE BIOMASS REMOVED FROM THE SECONDARY CLARIFIER FOR STABILIZATION, DEWATERING, AND OFF-SITE DISPOSAL.



BIOLOGICAL PROCESS SEQUENCE SCHEMATIC

1 = BAR SCREEN

2 = PRIMARY CLARIFIER

3 = TRICKLING FILTER (BIOFILM UNIT PROCESS)

4 = ACTIVATED SLUDGE (SUSPENDED BIOMASS UNIT PROCESS)

5 = SECONDARY CLARIFIER