

# TRAINING OF TRAINERS PROGRAMME ON CAPACITY DEVELOPMENT OF ETP OPERATORS

Promotion of Sustainability in the Textile and Garment Industry in Asia - FABRIC



**Day 5: Presentation 1**

# Advanced biological Treatment



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- Advanced aerobic treatment
- MBBR, SBR and RBC

# Advanced biological treatment overview



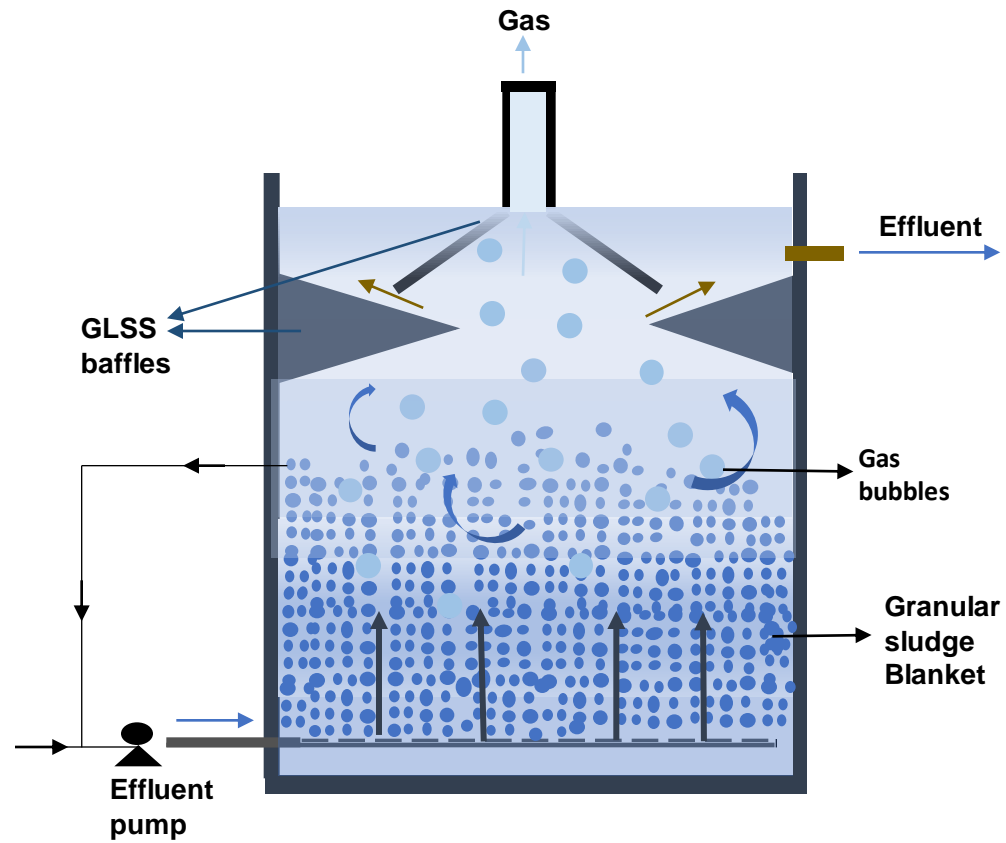
- Many efforts to improve efficiency, land requirement, power requirement, less O & M etc.
- Numerous variations of advanced biological systems, both in anaerobic & aerobic treatment.
- Many are proprietary technology which cannot be discussed in a general training program. Also, there are too many such technologies.
- Hence, only UASB and its variant as well as MBBR, SBR, RBC is reviewed here.
- The most emerging system, viz, MBR is discussed in another session.

# Upflow anaerobic sludge blanket reactor



- UASBR is relatively newer and popular anaerobic treatment system.
- Few UASBs in textile ETPs of Bangladesh.
- UASB work on principle of anaerobic bacteria concentrated in a blanket of bio-sludge.
- Sludge blanket has 3-6% of solids concentration. Effluent passes through sludge, gets treated.
- Sludge blanket is retained in suspension due to upflow of sufficient velocity by inflow pump and recycle (when no flow).

# UASB Reactor



# USBR operation principle



- Sludge blanket consists of anaerobic bacteria as flocs consist of suspended solids, undigested organics and the micro-organisms.
- Apart from the upflow of effluent, the gas produced also create turbulence and upflow movement within the reactor.
- A separation arrangement is needed to separate solids (to be retained), from the liquid and gas
- It is done through special baffle arrangement called GLSS (gas-liquid-solids separator) installed at the top of the reactor.

**What are the benefits & draw backs of UASB?**



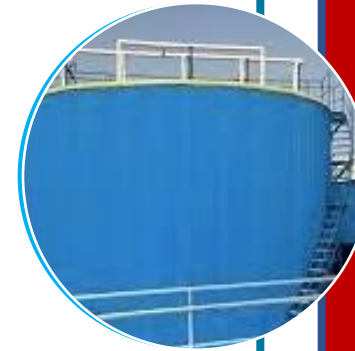


# UASB Reactors



## Advantages of UASB reactors

- Very low operating cost vis-à-vis aerobic systems.
- Very less space requirement
- Good treatment efficiency (upto 70% BOD reduction)
- Lower hydraulic retention times (4-8 hours) than other units
- Potential for gas generation in organic rich effluents.



## Disadvantages of UASB reactors

- low efficiency in difficult to degrade effluents (e.g textile effluent)
- Relatively higher O & M needs than other anaerobic reactors.
- Potential for foul smell if not operated properly.

# Expanded Granular sludge Bed reactor (EGSB)



*'Bio-MOD' EGSB by Aquatech*

- One disadvantage of UASB - if higher inorganic suspended solids admitted, it gets trapped in sludge bed and reduce efficiency.
- An expanded granular sludge bed (EGSB) reactor is a variant of UASB, which overcomes this handicap.
- The improvement in designed is a faster rate of upward-flow velocity for through the sludge bed.
- This higher velocity permits partial expansion and fluidisation of the granular sludge bed.
- There are many proprietary variants of EGSB.

# Expanded Granular sludge Bed reactor (EGSB)



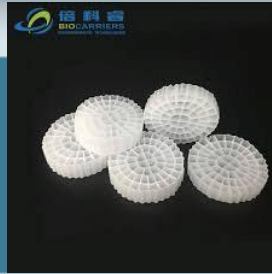
*'Bio-MOD' EGSB by Aquatech*

- Fluidisation improves wastewater-sludge contact, improve segregation of small inactive suspended particles from sludge bed.
- Increased flow velocity is obtained by recycling part of treated effluent and keeping a taller water column.
- The EGSB design is appropriate for low strength soluble wastewaters (less than 2000 mg/l COD)
- It is also suitable for wastewaters that contain inert or poorly biodegradable suspended particles

# Moving bed bio-reactors



'modernized' version of trickling filter. Special plastic media with high surface area (upto 4000 of m<sup>2</sup> /m<sup>3</sup>)



The bacterial slime growing over media disintegrates organics in effluent into carbon dioxide and water.

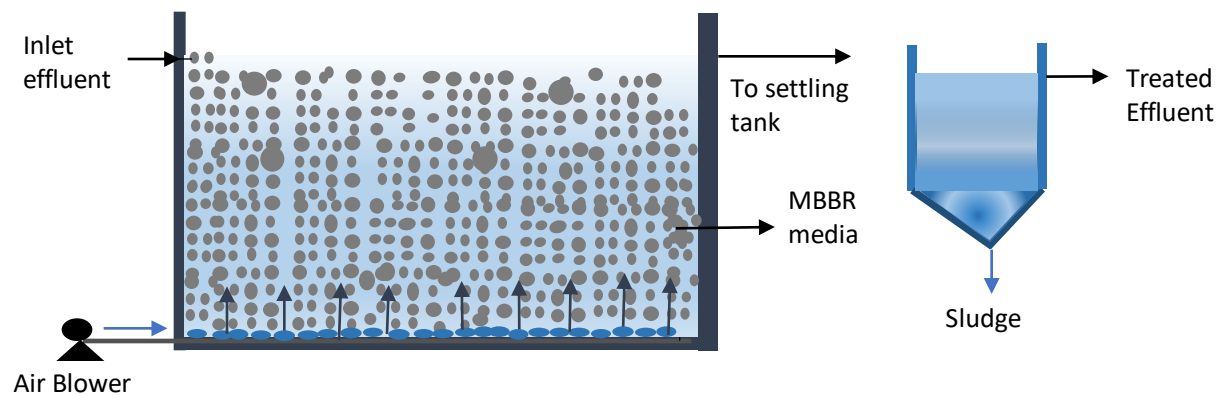
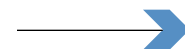


MBBR uses small (10-25 mm dia) media. Unit of larger size media is Fluidised Aerobic Bed reactor.



Outlet of MBBR is taken to settling tank. Small FAB reactors have an integrated settling compartment.

# MBBR



**What are the benefits & draw backs of MBBR?**

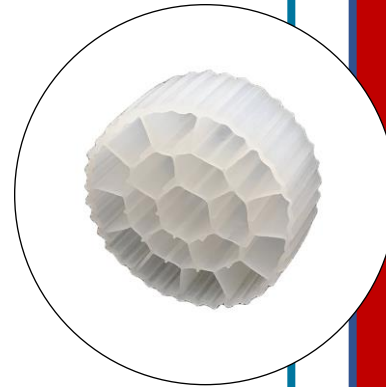


# UASB Reactors



## Advantages of MBBR

- smaller area compared to conventional treatment
- high efficiency in BOD/COD removal.
- O & M is not complicated
- Lower hydraulic retention time
- Resistant to shock loads



## Disadvantages of MBBR

- Not possible to automate the operation like SBR
- Some badly maintained unit -problems with insects.
- Skilled operators are required to control the system
- Need to keep media from getting washed out

# Attached growth systems - RBC



- RBC has series of closely spaced, parallel discs mounted on rotating shaft.
- Microorganisms grow on surface of plastic discs rotating in at 2 -5 5 RPM.
- Rotation help slough off excess solids.
- Discs rotate at right angles to the flow, with several packs, 40% of disc area is immersed.
- Biological slime layer attached to disc surface. Discs contact wastewater & atmospheric air as it rotates.



# Attached growth systems - RBC



- The discs consist of plastic sheets ranging from 2 to 4 m in diameter and are up to 10 mm thick.
- Approximately 95% of surface area is thus alternately submerged in wastewater and then exposed to air
- Most design of RBC systems will include a minimum of 4 or 5 modules in series to obtain nitrification of waste water.
- Input to RBC is well settled to remove all suspended solids to prevent any settlement of solids in the RBC trough.

# Attached growth systems - RBC



**What are the benefits & draw backs of RBC?**



# UASB Reactors



## Advantages of RBC

- Short contact periods: large surface. Handle flow variations.
- Sloughed biomass can be easily settled.
- Less chance for effluent channeling
- Low power requirements : low O & M costs
- Low sludge production and excellent process control.



## Disadvantages of RBC

- Lower pathogen removal
- Not easy to repair or replace in case of repair
- Lower aeration efficiency at higher temperature
- Not suitable for high strength effluents

# Suspended growth systems - SBR



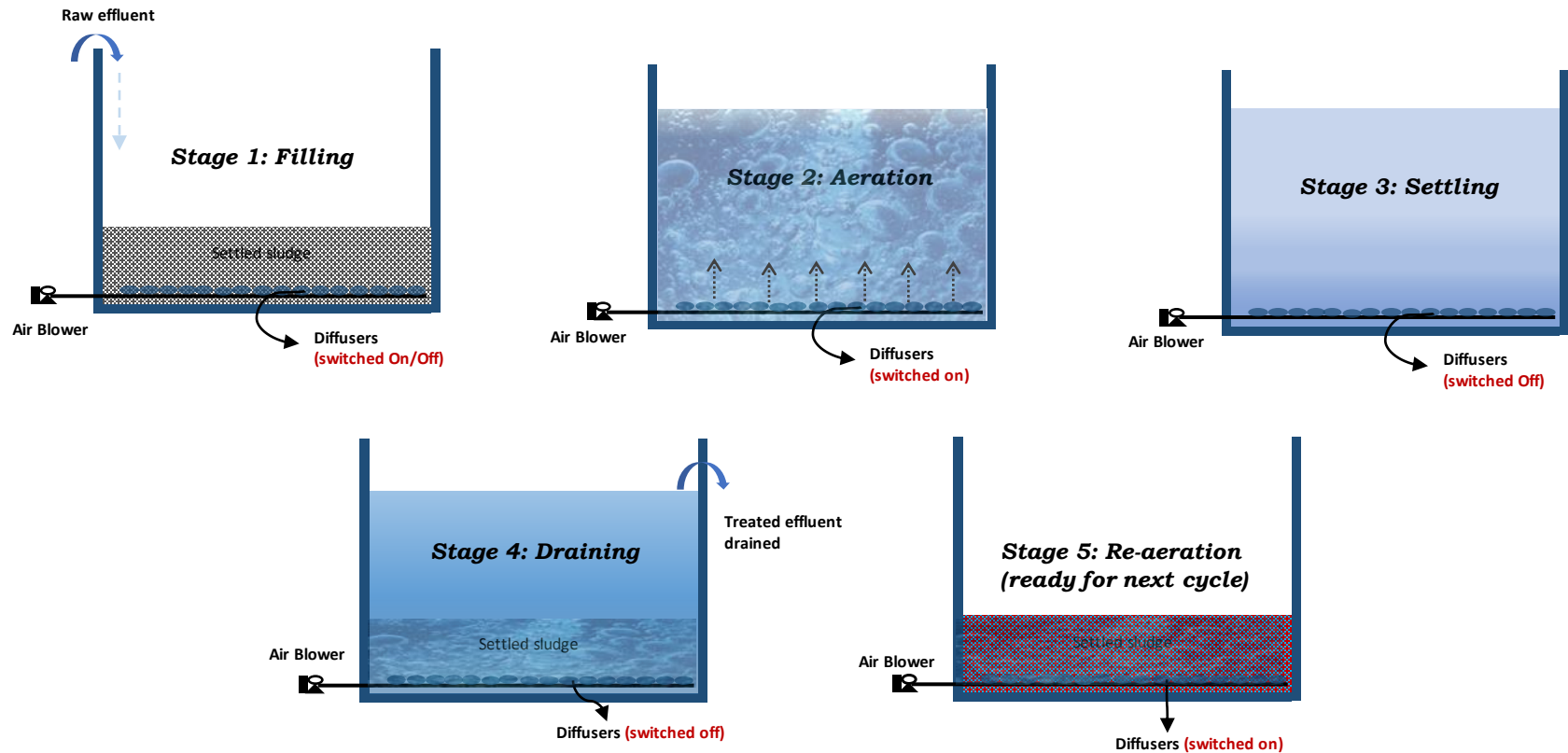
- In conventional ASPs, aeration tank outlet is settled in settling tank and sludge is returned to aeration tank.
- if system operates as batch process & sludge is allowed to settle within the same aeration tank, it is called SBR.
- To begin, effluent is admitted into the aeration tank with bio-sludge in it and then it is aerated for a fixed period (say 4-6 hours).
- Then the aeration is switched off, bio-sludge is allowed to settle. Clear supernatant is drained off.

# Suspended growth systems - SBR



- Once draining of water except settled sludge is over, tank is filled with fresh effluent, aeration re-started.
- SBRs usually constructed in multiple units (one set under aeration, other settle) and controlled automatically.
- Outlet pipe mounted on float to smoothly decant supernatant after settling: save time and sludge carry over.
- Typical cycle time 8-14 hours. Some wasting of excess sludge would be done occasionally.

# Suspended growth systems - SBR



# Suspended growth systems - SBR





**What are the benefits & drawbacks of SBR?**



# Suspended growth systems - SBR

## Advantages of SBR

- Simple operation
- lesser capital cost,
- relatively lower area requirement,
- high treatment efficiency and flexibility in operation



## Disadvantages of SBR

- Lower pathogen removal
- Not easy to repair or replace in case of repair
- Lower aeration efficiency at higher temperature
- Not suitable for high strength effluents



# Conclusion



- Most of the effluent treatment plants installed in the world uses one type of biological treatment or other.
- Anaerobic like UASBs is used in organic rich effluents (distillery, brewery, starch industries and also in sewage)
- Most ETPs use activated sludge systems.

# Conclusion



- Textile ETPs in Bangladesh either primary ETPs or combined with biological or all-biological treatment ETPs.
- Many primary ETPs are getting upgraded to combined or all-biological treatment, some opt for advanced systems too.
- Many new ETPs uses advanced variants such as MBBR, MBR, SBR or RBC.

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