Innovative Technologies for Urban Waste Water Treatment

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4th March 2013
URBAN WASTE WATER - SEWAGE

Source of

- Foul odour
- Infectious Diseases
- Surface and Ground Water Pollution (Organics, Detergents, Medicinal residues, Hormones, Bacteria, Pathogens, Virus, etc.)
- Eutrophication of Water Bodies
- Huge volume of polluting water

Series of Treatment steps required to remove

- Foul odour, Grit, Floating matter
- Suspended Solids (TSS)
- Soluble Carbon - Organics (BOD)
- Nutrients – Nitrogen, Phosphorus
- Bacteria, Pathogens, Virus
Issues driving the technology progression

- Population Growth, Development & Shrinking Urban space.
- Growing realization to upgrade Urban Sanitation System.
- Pollution of raw water resources.
- “Acceptance” of the fact that Waste Water could be turned into “Resource”.
- Statutory Standards & Monitoring for compliance getting stringent.

Growing acceptability to Recycle & Reuse

- Use for Horticulture / Urban Landscaping
- Washing of vehicles / public transport
- Raw water for Industrial application
- And, possibility of INDIRECT Potable Use.

*It's all about Sustainable Development*
Urban Waste Water Treatment
Several possibilities for Innovation

PRE-TREATMENT (PHYSICAL)
- Medium & Fine Screening
- Grit Removal
- Oil & Grease Removal

PRIMARY TREATMENT (PHYSICAL / CHEMICAL / BIOLOGICAL)
- Clarification
- Chemically Enhanced clarification
- Anaerobic Treatment (Biological)

SECONDARY TREATMENT (BIOLOGICAL)
- Activated Sludge Process (CASP / BNR)
- Submerged Media Aerobic Bio-Filteration
- Moving Bed Biological Reactor (MBBR) / (IFAS)

SLUDGE MANAGEMENT
- Sludge Thickening
- Sludge Anaerobic Digestion/Stabilisation
- Dewatering / Solar Drying

BY-PRODUCTS DISPOSAL / REUSE
- Sludge for Land Filling / Agriculture Manure
- Biogas for Electrical Energy Production
- Sludge Thermal Oxidation & Energy Recovery

Disposal by Land Filling

Disposal / Reuse

TREATED EFFLUENT
- Activated Sludge Process (EA / BNR)
- Sequential Batch Reactor (SBR)
- Moving Bed Biological Reactor (MBBR / IFAS)
- Membrane Biological Reactor (MBR)
Urban Waste Water Treatment
Innovative Secondary Treatment

- **Suspended Growth Process**
  - Activated Sludge Process (ASP / BNR)
  - Sequential Batch Reactor (SBR)

- **Immobilized media Process**
  - Biological Filtration Oxygenated Reactor (BIOFOR)

- **Micro/ Ultra membrane Filtration Process**
  - Membrane Biological Reactor (MBR)
The 20\textsuperscript{th} Century : The Birth of Activated Sludge Process

\textbf{Year 1908} : BOD\textsubscript{5} Test recommended by The Royal Commission on River Pollution (U.K.).

\textbf{Year 1912} : Famous “30 : 20 + Full Nitrification” Effluent standard was adopted which led to the development of treatment processes capable of meeting the standards.

\textbf{Year 1913} : Activated Sludge Process developed in Britain. The process not only improved the treated effluent quality but also resulted in over 4 fold reduction in the size of the plant compared to the contemporary treatment systems.

\textbf{Year 1916} : First full scale Activated Sludge Plant built in Worcester (U.K.)

\textbf{ACTIVATED SLUDGE PROCESS IS STILL THE DOMINANT SECONDARY TREATMENT PROCESS AND THE “ENGINE” AROUND WHICH MODERN SEWAGE TREATMENT PROCESSES ARE DEVELOPED.}
Suspended Growth Process
- The Sequential Batch Reactor (SBR)

- CYCLOR® by Degrémont
Urban Waste Water Treatment
Innovative Technologies - SBR

Continuous Operation ASP

Biological Reactor + Secondary Clarifier

Sequential Batch Operation

CYCLOR® SBR
In SBR, various stages of treatment are not separated by units but by time.
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CYCLOR® SBR

Pre-treated Waste Water → Reactor Basin

Decanter to evacuate treated effluent

All SBR BASINS with Aeration system & Decanter

TREATED EFFLUENT

Aeration System
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Urban Waste Water Treatment
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ADVANTAGES

- Extensive biological treatment – efficient removal of C, N, P.
- Good sludge settling conditions – good effluent quality (BOD<10, TSS<15).
- A simple system - easy to operate & needing little maintenance.
- PLC based Automated Control system – minimum human intervention.
- A flexible process - treatment stability even in the case of a breakdown.
- A reliable and optimised process.
Fixed Media Attached Growth Process
- The Submerged Aerobic Biological Filters

- BIOFOR® by Degrémont
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Innovative Technologies - Biofilters

- Attached Growth on submerged Media
- Co-current and Up-flow
- Aerobic process
- Biological Process & Physical Filtration simultaneously in the same Unit,

Biofilter in operation, Primary Treated Sewage channel

Biofilter under Backwashing
Treated effluent
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Innovative Technologies - Biofilters

- Process (Oxygenation) Air
- Loosening (Scour) Air
- Treated Effluent
- Dirty Wash Water Outlet
- Wash Water
- Pretreated Sewage
- Trapped Particulates
- Submerged Media
- Biomass film
- Diffused Aeration
- Air and Sewage Flow Co-Current

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Delhi Gate Nalla STP
Example of Innovative Technology

- 15 MIGD Capacity - sewage/wastewater from open drain.
- STP with Power Generation using Non-conventional Energy Source (Biogas)
- 2.5 Ha Area used versus 8 Ha for Conventional.
- Tertiary Standards (BOD <10, mg/l, TSS < 10 mg/l)
- over 80% Energy Self Sufficiency
- Low Carbon Footprint
- Odour removal provision.
ADVANTAGES

- Compactness, Modularity
- Biomass Stability
- High Treatment Reliability
- Energy savings
- Tertiary Quality effluent (BOD < 10, TSS<10)
- No smell and Odour nuisance
Suspended Growth Process
- The Membrane Bioreactor (MBR)

- ULTRAFORE® by Degrémont
**In MBR, the Membrane forms a Physical barrier for bio-sludge / mixed liquor from bio-reactor.**

**The use of Membrane as a barrier for suspended solids / biomass enables the process designer to stretch the limits of activated sludge process and achieve extra-ordinary results.**
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Innovative Technologies - MBR

Bioreactor + Membrane Filter = Membrane Bioreactor

Conventional TTP Process

Primary Clarifier → Activated Sludge → Secondary Clarifier → Sand Filter → Sludge Digestion → To Sludge Dewatering

ULTRAFORE® MBR Process

Feed → Permeate → Air
**MBR MEMBRANES – SUBMERGED TYPE**

Fibre = 0.035 µ

Cassette = 30 - 60 Elements

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ADVANTAGES

- Best tertiary quality effluent in shortest treatment line.
- Compact (Smaller bioreactor, no clarifiers, no sand filters)
- Reliable (Performance independent of sludge settling characteristics)
- Entirely aerobic (no odors)
- Readily adaptable for N & P removal
- Ideal For Staged Expansion
- Best choice to meet effluent quality for Hygienic REUSE
Urban Waste Water Treatment
Innovative Technologies - Installations

- Colombes (Paris), FRANCE
  - 1,035 MLD (DWF 240 MLD)
- COMPACT FOOTPRINT
  - 3.2 hectare (U/G)
  - 1.3 hectare (O/G)
60,000 m³/day capacity TTP at V-Valley, Bangalore
- Largest sewage TTP in India for Industrial Re-use of treated effluent

Designed & Built by Degremont
1,500 m$^3$/day Membrane Bioreactor at Cubbon park, Bangalore:
- First MBR Plant in India for Urban Landscaping reuse of treated sewage

Designed & Built by Degremont
Emerging Technologies in 21st Century

- **Microbial Fuel Cell (Biofuel Cell Technology)**
  - simultaneous treatment of waste-water and energy generation

- **Bio-membrane Systems**
  - extraction system / fixed film system / filtration system

- **Advanced Oxidation Process**
  - Heterogeneous Photocatalytic Processes to generate reactive hydroxyl group (combination of special metal oxides (i.e TiO$_2$) with UV system)

- **Nano Technology for pollution prevention, treatment and remediation**
  - Nanotech Membranes, Nanosorbents, Nanoreactors…
THANK YOU