Energy Efficient Urban Wastewater Treatment using Phytorid

At Center of India: Nagpur

Rajesh B. Biniwale, Ph.D., D.Sc.

Principal Scientist,
Environmental Materials Division
National Environmental Engineering Research Institute
Nagpur 440020 India

rb_biniwale@neeri.res.in

Pondicherry August 12, 2013

Institute

- CSIR Laboratory
- HQ Nagpur, 5 Zonal Labs
- 150 Scientist
- 300 Project Fellows
- 300 other technical & supporting staff
- Annual Budget of Rs. 240 Millions
- ECF 50 %

- R&D Thrust Areas
  - Environmental Monitoring
  - Environmental Modeling
  - Environmental Materials
  - Environmental Biotechnology & Genomics
  - Environmental System Design and Optimization
  - Environmental Impact & Risk Assessment
  - Environmental Policy
- Advisory
  - Industries
  - Central Govt. Ministries/Boards
  - State Govt. Ministries/Boards
  - Judiciary

Urban Waste Water Management

Sources

- Municipal/domestic waste water
- Strom water discharges
- Hotel and Offices
- Agricultural runoff
- Landfill leachates
- Industrial wastewater

Impact

- Ground water pollution
- Eutrophication of lakes and other water bodies
- Degradation of river water quality
- Impact on public health

Treatment

- Reuse/recycle
- Avoiding contaminations in water bodies
- Decentralized approach for reducing pressure on civic bodies

Starting with Myths of Waste Water (especially Sewage) Treatment

- Mechanical parts essential
- Treatment must be Complex
- It needs to be away from site : Beyond city limits
- High and Best Technologies

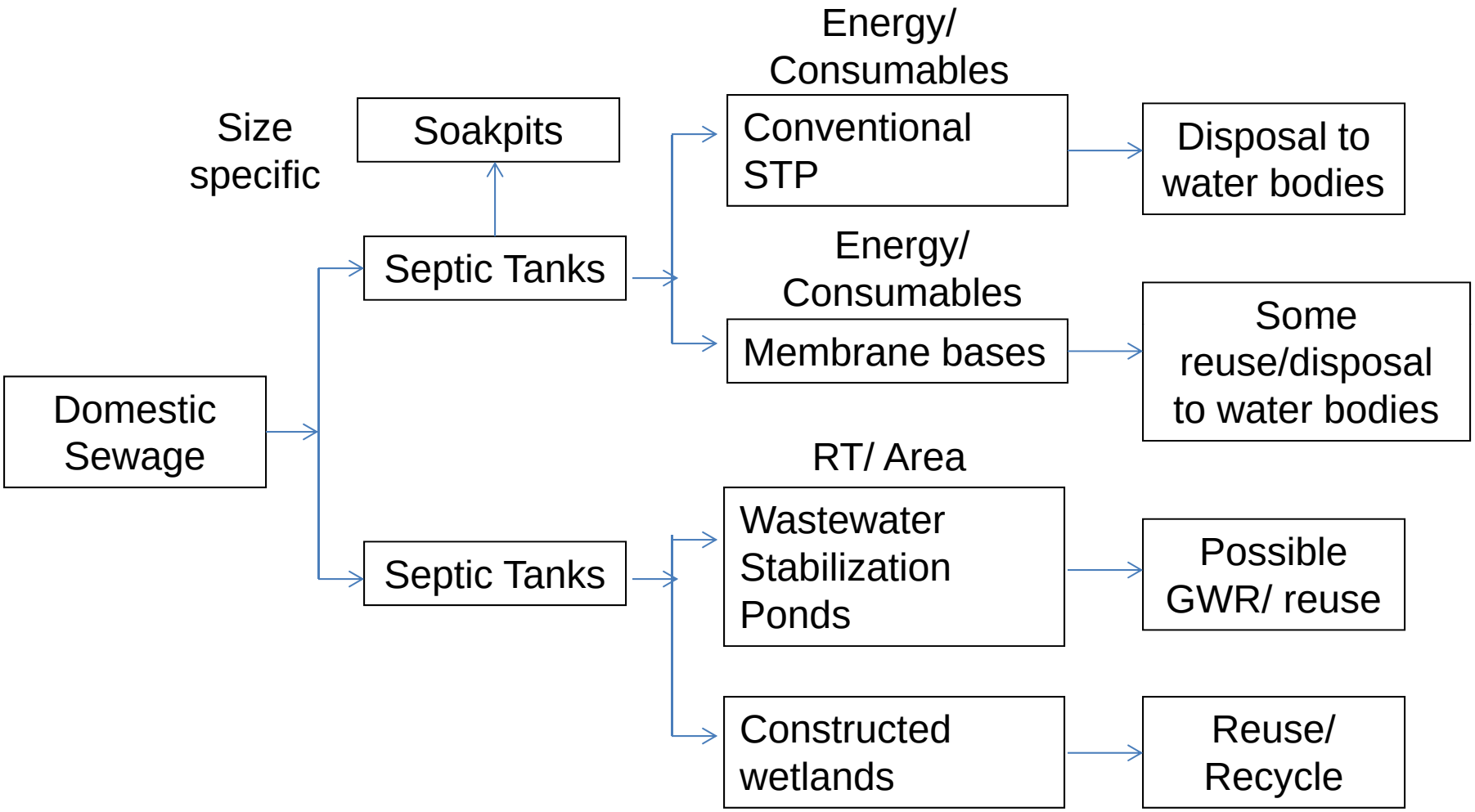
Why Decentralized?

- Improve reachability, reduce the need for sewage transportation system
- Allowing use of the treated water in-situ
- Minimizing pumping, transportation, thus energy efficient
- Smaller systems technically empowering the smaller LUBs
- Treatment where it is needed

Sewage unexplored resource

- Irony of the situation: more than 80% of water converted to sewage
- Out of this sewage more than 90-95 is still water
- No water available in revers and nallahs are perennial

Methods, Issues, solutions



Innovations in Technological Solutions

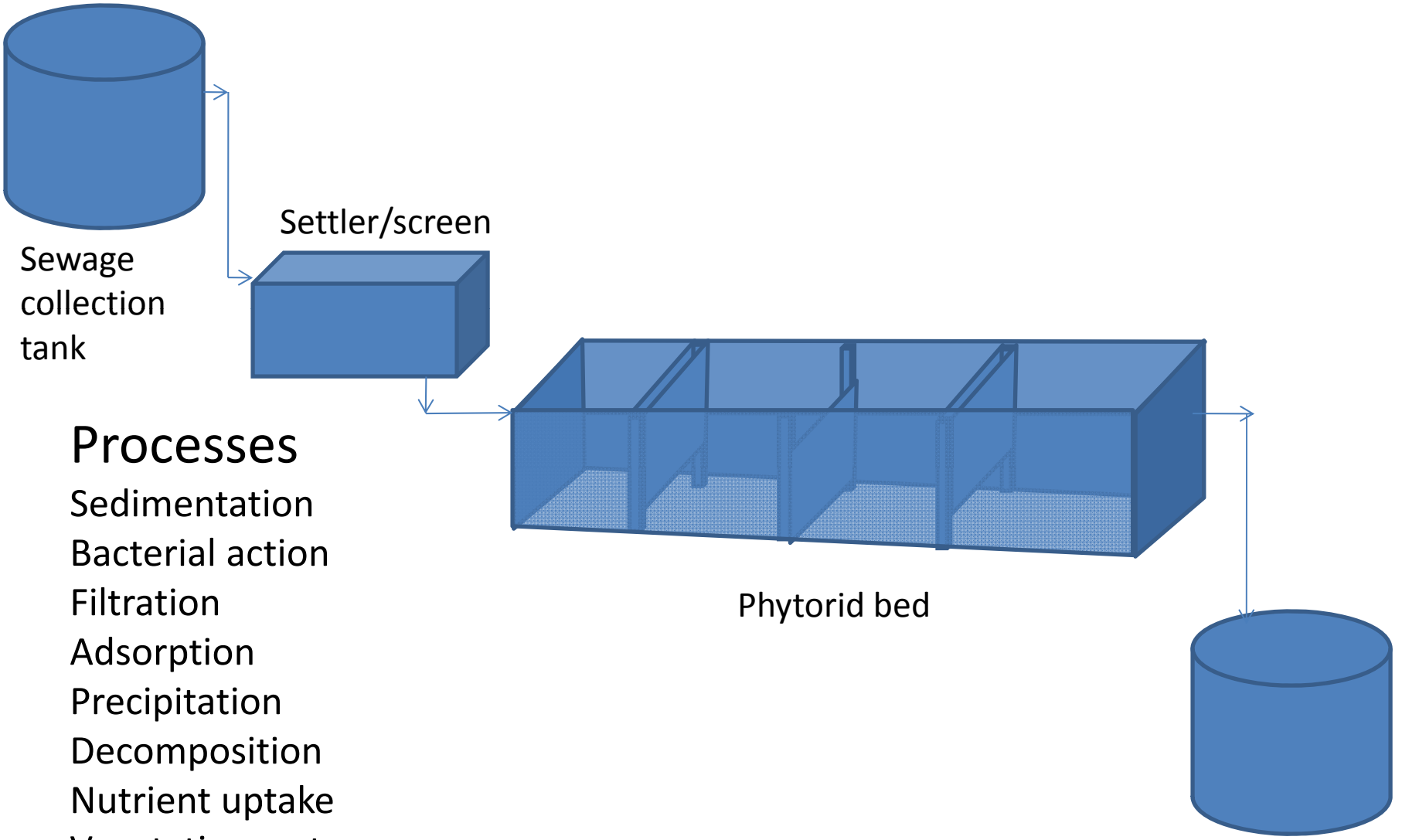
Command and control approach

Ecosystem- based approach

NEERI's PHYTORID
A Constructed Wetland System

- Based on 5 years of intense R&D in lab, pilot
- Now more than 7 years of field experience of plants
- Innovation based on:
  - Our climate
  - Our needs
  - Our cost issues
  - O&M practices
- International Patents:
  - Australian Patent
  - European Patent
  - Indian Patent

Components of PHYTORID system



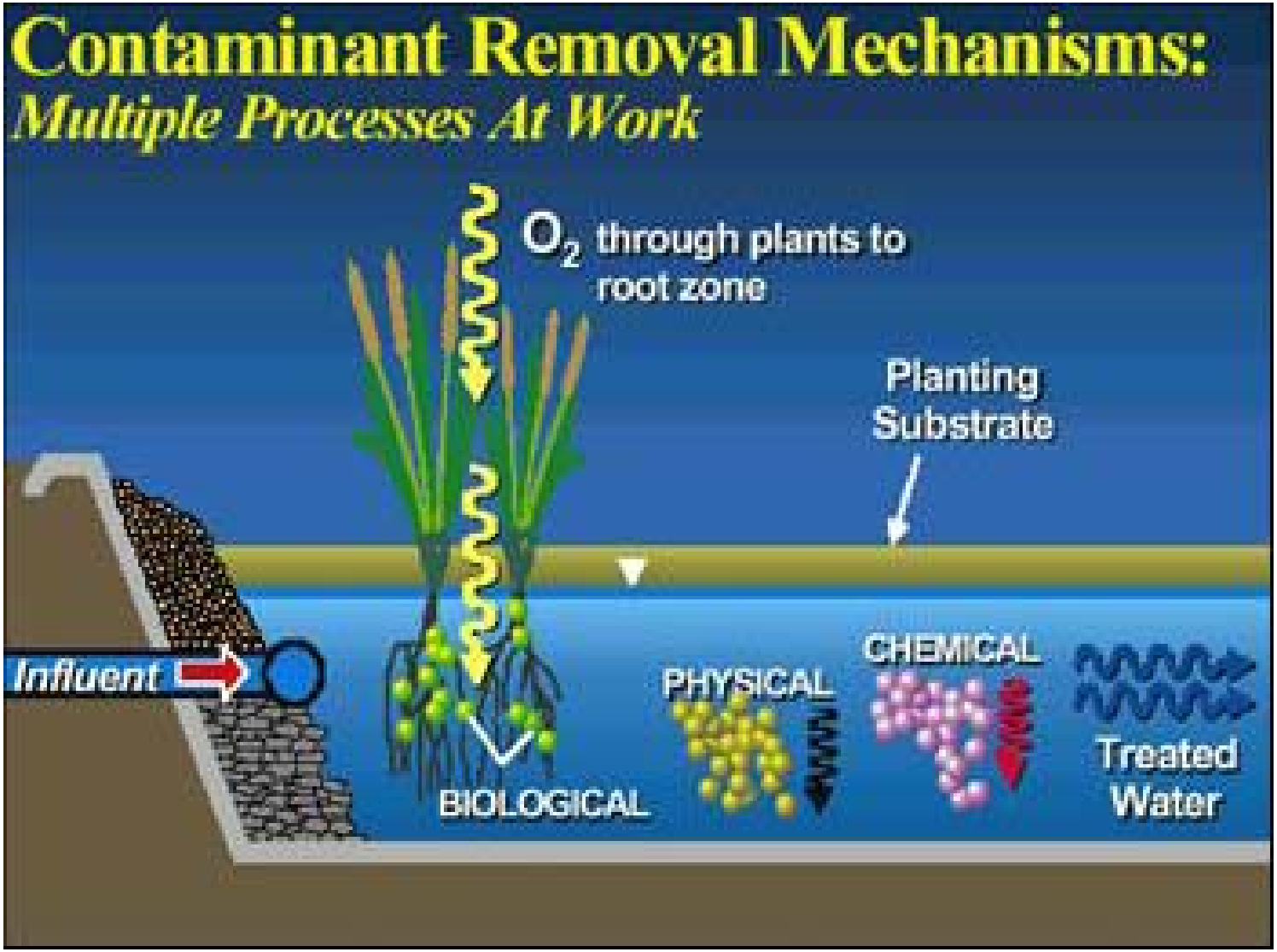
Processes

Sedimentation
Bacterial action
Filtration
Adsorption
Precipitation
Decomposition
Nutrient uptake
Vegetation system

WETLAND COMPRISES……

- **Primary Settling Cell** (PSC) for the purpose of anaerobic pretreatment of suspended solids.
- **Secondary Advanced Filter Cell** (SAFC), that supports a permutation of different sizes of stones and gravel wherein anaerobic digestion occurs.
- **Tertiary Biological Wetland Cell** (TBWC) made up of different layers of life supporting media such as those used in SAFC and planted with aquatic flora such as Typha, Scirpus, Cyperus, Peltandra and Phragmites.

Phytorid Details



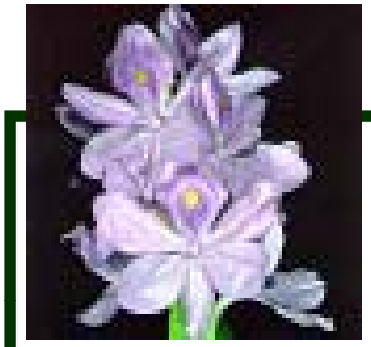
Design Approach

- Operating windows for sewage, parameters
- Source based selection of unit operations
- Space availability and levels
- Proximity of end use of treated water
- Quality of water required
- Soil strata
- Design of plant, conceptual, structural and asthetics

Typical Performance Characteristics for Various Treatment Methods

Sr.	Items	Conventional activated sludge	UASB	Extended Aeration	Facultative Aerated Lagoons	PhytoRid Technology
1	Performance BOD Removal %	85-92	75-78	95-98	75-85	80-95
2.	Sludge	First digest then dry on beds or use mech devices	Directly dry on beds or use mech devices	No digestion dry on sand beds or use mech devices	Mech. Desludging once in 5-10 years	Negligible
3.	Equipment Requirement (excluding screening and grit removal common to all processes)	Aerators, recycle pumps, scrappers, thickeners, digesters, dryers gas equipment	Nil except gas collection and flaring gas conversion to elect is optional	Aerations, recycle pumps sludge, scrappers for large settlers	Aerators only	None, all flows by gravity
4.	Operational Characteristics	Skilled operation reqd.	Simpler than ASP	Simpler than ASP	Simple	Unskilled operator
5.	Special features	Considerable equipment and skilled operation reqd specially when gas collection and usage considered	Minimal to negligible power reqd. makes it economical at even if gas revenue is neglected	BOD removal highest effluent nitrified high power reqd. Favoured for small and medium plants	Power reqd. similar to ASP operation simpler	Plant species and odour less operations

Various Plant Types



Forage Kochia	*Kochia spp*
Poplar Trees	*Populus spp*
Willow Trees	*Salix spp*
Alfalfa	*Medicago sativa*
Cattail	Typha latifolia
Coontail	*Ceratophyllum demersum L*
Bullrush	Scirpus spp
Reed	*Phragmites spp.*
American pondweed	*Potamogeton nodosus*
Common Arrowhead	*Sagittaria latifolia*

ADVANTAGES

- Cost-effective
- Operation and maintenance expenses are negligible.
- Minimum electricity requirement, nearly fossil energy free
- Smaller footprint (Retention time: Typically less than 24 hrs.)
- Facilitates recycle and reuse of water
- No foul odor and No Mosquito Nuisance.
- Tolerates fluctuations in operating conditions such as flow, temperature and pH

Aesthetics and NO Dedicated SPACE

Subsurface Flow:

- **NO water logging on top**
- **NO Blockage by sewage-solids**

APPLICATION

PHYTORID **system is useful for treatment of waste water in following applications**

- **Domestic wastewater (including decentralized Municipal waste water treatment)**
  - **Colonies, Airports, Commercial complexes, Hotels**
  - **Open drainage**
  - **Cleaning of nallah water**
- **Agricultural wastewater**
- **Dairy waste**
- **Slaughter House Waste**
- **Fish pond discharges**
- **Pre treated industrial wastewater, Sugar Industries**
- **Municipal Landfill leachates**
- **Several other applications**

Performance of PHYTORID for urban waste

Pollutant	Performance (% removal)
Total suspended solids	85 – 95
Biochemical oxygen demand	80 – 90
Chemical oxygen demand	80 – 95
Total nitrogen	60 – 80
Phosphate	60 – 80
Fecal coliform	>99

Treated water quality will meet the specified norms of CPCB/MPCB for water reuse

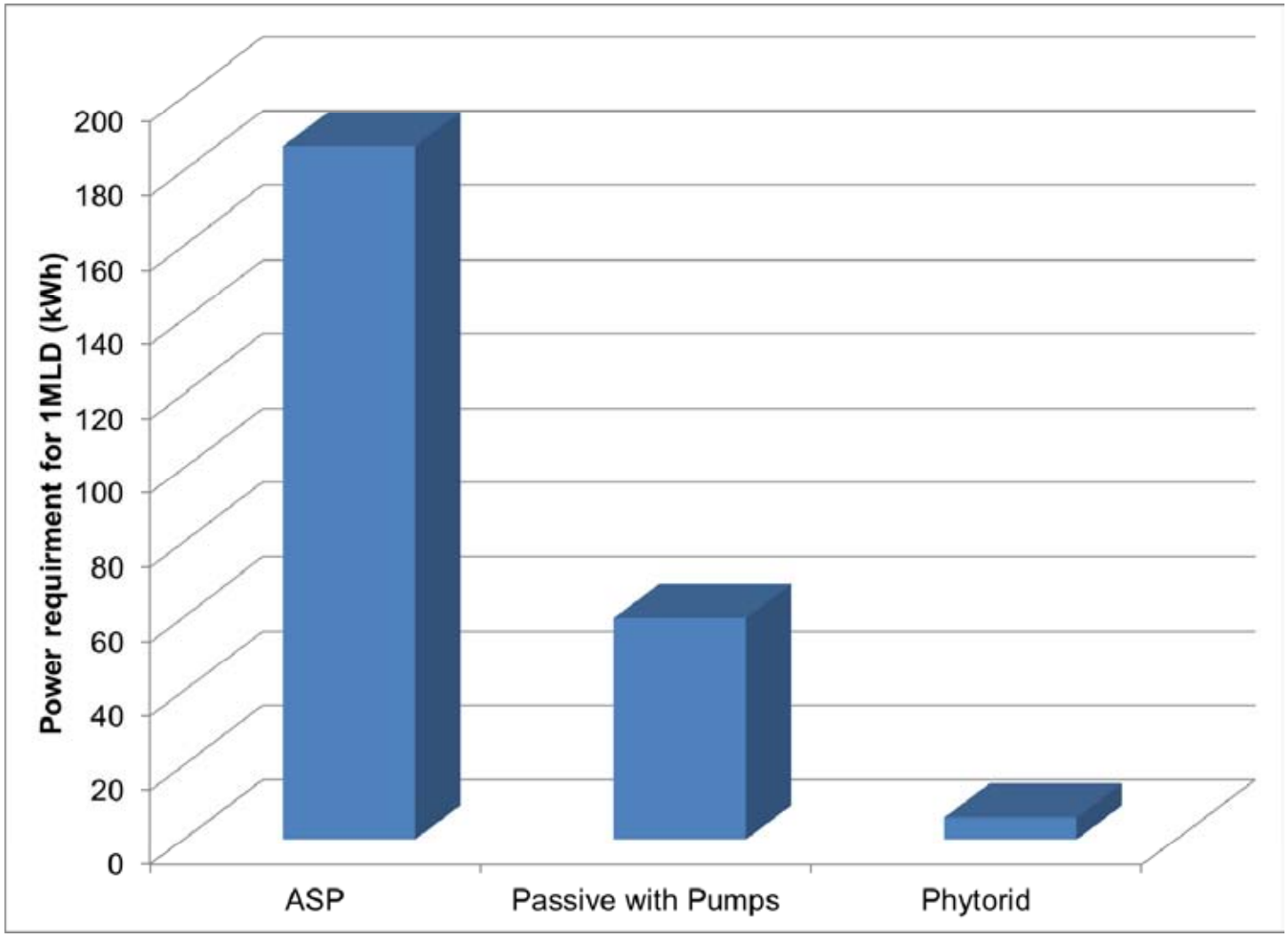
PRODUCT WATER QUALITY

- Treated water complies to the regulations laid down by MPCB/CPCB(Table IV fresh water category) to reuse the water for the purpose of discharge, gardening agriculture etc.

GREEN POINTS

- Best Adoptable technology for in-situ treatment and reuse of waste water
- Phytorid Technology carryout on-site treatment and reuse of grey water up to 95%, which would attract total of 5 credits on Indian Green Building Certification (IGBC).

A Typical Energy Comparison



Inaugurated by
Shri Suresh Shetty

(Honbl'e State Minister)
Medical Education Higher & Technical Education

On

World Environment Day
5th June, 2006

at

Kalina Campus
Mumbai University

Phytorid for nallah water treatment

Plant at Agricultural college, PKV Nagpur
Plant Capacity 100 m^3/day

Raw sewage in nallah

Phytorid System

Treated water

Conclusions

- Phytorid is the needed innovative technology: Ecologically benign
- Nearly free of fossil based energy therefore sustainable and doable
- Cost effective in terms of O&M is most important factor

Thank You

Contact
Dr. Rajesh Biniwale
(M) 09822745768
rb_biniwale@neeri.res.in