Natural Treatment Systems for Reclaimed Water Use and Bioresource Recovery: A Palestinian Experience

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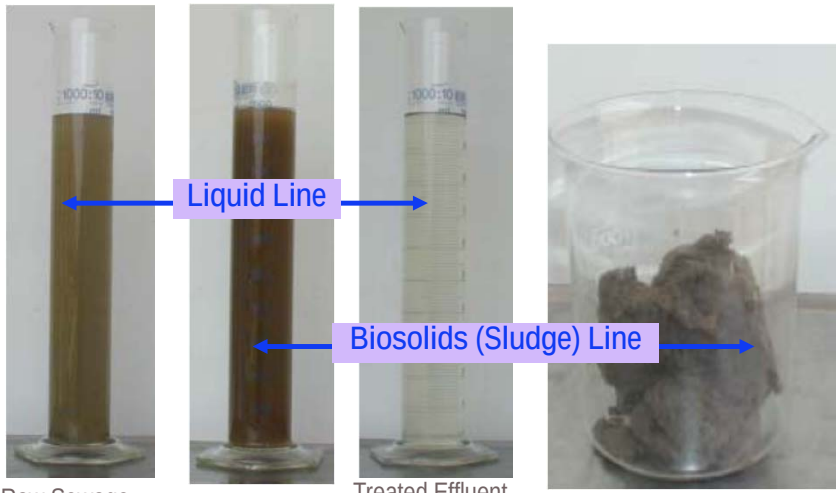
Outline

- Principles and products of wastewater treatment
- Wastewater quality & sewage works performance
- Current status of natural wastewater treatment systems in selective Palestinian communities
- Research and development at Birzeit University
- Future perspectives

Principals & Products of Wastewater Treatment

- Physical and/or chemical separation of suspended material, particulate, non-biodegradables, fats/lipids
- Biological reduction of dissolved organic and inorganic mater using plants, algae, or microorganisms under aerobic/anoxic/anaerobic processes.
- Production of treated/reclaimed water and stabilized biosolids (sludge) for a safe use/disposal
- Resources recovery [N, P, K] and biogas [energy]

Wastewater Treatment Products



Wastewater Quality and Sewage Works Performance

- Rapid identification of toxic loads to biological processes
- Quality of solids separation in secondary settling tanks
- Optimization of power consumption in wastewater treatment
- Prevention of pipeline clogging by biofilm and TSS
- Improve biogas production, treatment and quality
- Process modeling and failures prediction of biological processes

Wastewater Quality and Sewage Works Performance *(cont`d)*

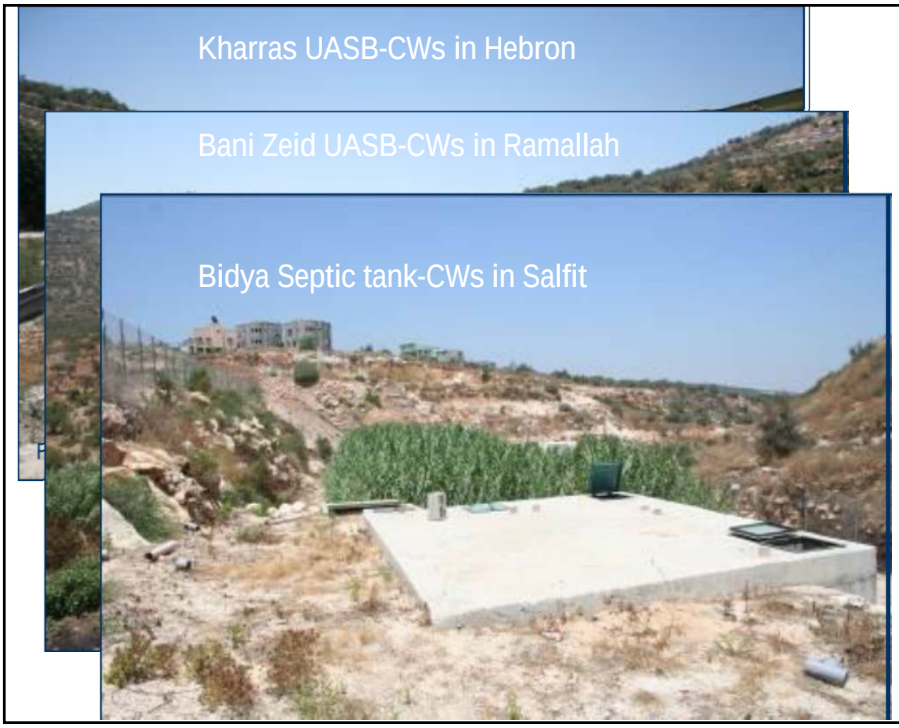
- Preventing infiltration rates fall in SAT recharge basins
- Preventing biofilm formation in effluent pipelines used in irrigation schemes
- Improving the removal of dissolved organic materials in the effluent by membrane processes
- Odors abatement and the need for biofilters installment
- Compliance with national guidelines for effluent reuse in irrigation - Need for pathogens analysis

Natural WWT systems in Palestinian communities

Waste Stabilization Ponds [WSPs] and Constructed Wetlands [CWs]

[WSPs]
- Anaerobic ponds [Tulkarm],1972/2004 rehab., about 70,000 PE
- Talita Kumi Bethlehem-Academic institution, 2000, about 500 PE

[CWs; *pretreatment in UASB or septic tank*]
- Nuba in Hebron, 2002, 1400 PE
- Kharras in Hebron, 2003, 1400 PE
- Bani Zaid/Deir Ghassane, 2004, 500 PE, Pilot system
- Hajja, Sarrah & Biddya villages, 2004, 150-500 PE
- Misilya town 2017, 4000 PE
- Several pilot scale Greywater treatment *[HHs, 738 OTS, ARIJ 2010]*



CWs Non-Functional to Moderate Efficacy?

- *Institutional*
- *Socio-Technical*
- *Financial*

Parameters	Value	
	Horizontal	Vertical
Organic Load (g $BOD_5/m^2.d$)	8*	14*
Mean depth of the filter media (m)	0.4-0.6	0.5-0.8

(Vymazal et al., 2008)

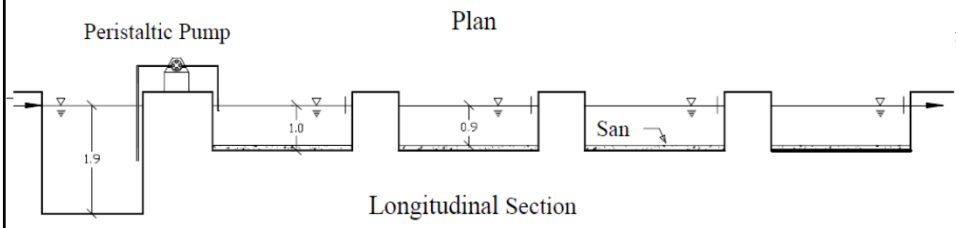
Research and Development at Birzeit University

- *PhD research since 1997, WASCAPAL Project (1997-2000)*
- *MSc Thesis works, WASTEVAL I &II projects (1998-2002)*

BZU Research & Training Site-PhD & MSc Thesis

Comparison between algae-based and duckweed-based wastewater treatment: differences in environmental conditions and nitrogen transformations. Wat. Sci. Tech., 2000. http://hdl.handle.net/20.500.11889/4630

Nitrogen Transformations and Removal Mechanisms in Algal and Duckweed Waste Stabilisation Ponds. PhD Thesis 2003. https://www.researchgate.net/



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Rock Filters Enhance Facultative Ponds Efficacy

Algae-Bacteria Ecosystem for WW Treatment & Reclamation

Novel design concept for facultative ponds using rock filters to reclaim the effluent. J. Environ. Eng., 2011. http://hdl.handle.net/20.500.11889/2769

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Talitha Kumi-MSc Thesis Theodory, 2002

Performance evaluation and monitoring of an appropriate low-cost wastewater treatment technology for small Palestinian communities. Proc. Regional Symposium on Wastewater Reclamation and Reuse. http://hdl.handle.net/20.500.11889/4723

PADUCO2 Proram-MSc Thesis Works

INWA project (BZU, PPU, IUG, IHE Delft) 2017-2019

Industrial wastewater treatment (Dairy, slaughterhouse, Olive oil mill wastewater)

- Feasibility of pretreatment technologies
- Post-treatment using constructed wetlands
- Post-treatment using waste stabilization ponds
- Phytoremediation for industrial pollution reduction

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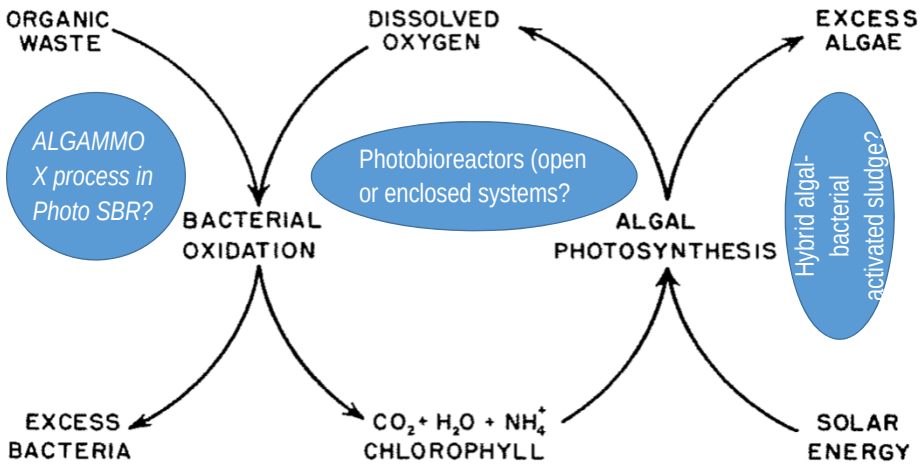
Future Perspectives

Natural treatment systems are efficient tools and environmentally friendly solutions for:

- wastewater treatment (domestic, municipal & industrial) for reclaimed water use
- cleanup of heavily polluted wadis, streams and contaminated sediment
- improvement of food supply via reclaimed water use in irrigation
- development of renewable bioenergy via biogas utilization [UASB]
- compared to physicochemical and mechanized systems, are less expensive technologies for WWT and site revitalization
- Phytoremediation can accumulate toxic metals and organics from hazardous wastewater and polluted sites

Phytotechnologies (WSPs & CWs) can only be sustainable if the institutional, sociotechnical and financial aspects are ensured

Feasibility of Large Scale Photobioreactors?



Adapted after Oswald & Gotaas, 1955. Oxygen cycle & algal production in WSPs