Ecological Wastewater Treatment by Tree-Root-Filter, Sustainable Sanitation-Solution for the Tropics:

An Example from the Central Amazon, Brazil.

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Tropical inlands reveal minor indices for wastewater treatment of the world. In the tropics, results of conventional wastewater treatment plants (WTP) are weak, because of their need for secure energy and specialists for maintenance and monitoring. A scheme of a conventional WTP shows the four normative steps of pre, primary and secondary treatment followed by disinfection, by use of energy and chemical products (Fig. 1). Noise, foam and odor emissions render impossible any installation in residential areas (Fig. 2).

Other problems of the inland are appropriation of domestic utilities, vandalism, mal construction caused by irregular financial release and, principally, the perceptible energetic uncertainty for calque and operating. These were the reasons for developing adopted systems by applied ecology, avoiding electrical energy and chemicals input.

Applied ecology does contribute to reducing consumption of energy for sanitation efforts (BMZ, 2011). On the other hand, Ecological Wastewater Treatment Plants (EWTP) by tropical tree root filters have the appearance of natural forest pads. Lack of emissions of unpleasant agents because of subsurface processes, no exposition of parts with domestic values and easy understanding of the natural depuration process, make EWTP to welcome urban equipment, even in habitational areas.

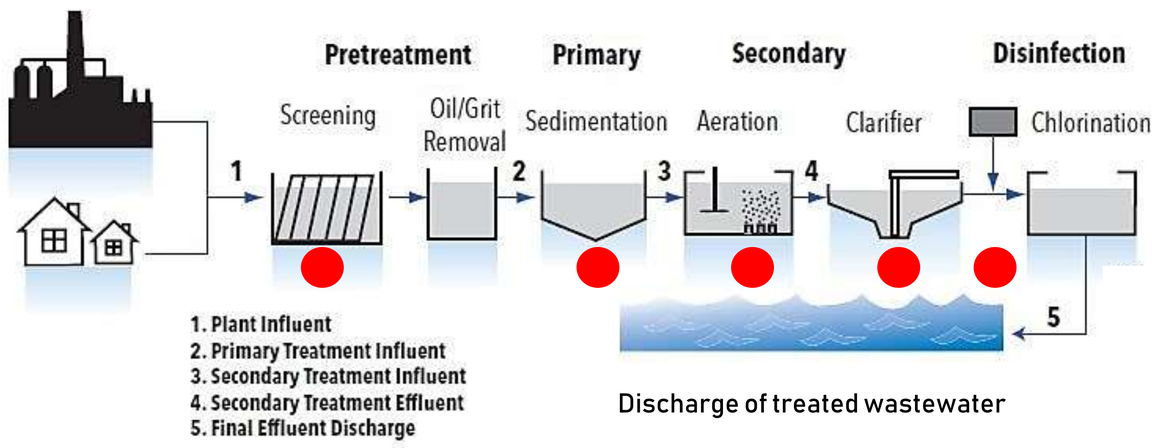

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Fig. 1 General scheme of a household- or industrial-wastewater treatment plant (WTP). The red dots mark energy input for moving parts, pumping, aeration, and stirring.

Fig. 2 Abandoned oxidation valley of a WTP in a residential area of Manaus city. Noise, foam and odor emissions led to public protest.

"The Amazon needs a strategy of low-tech solutions for sanitation by applied ecology"

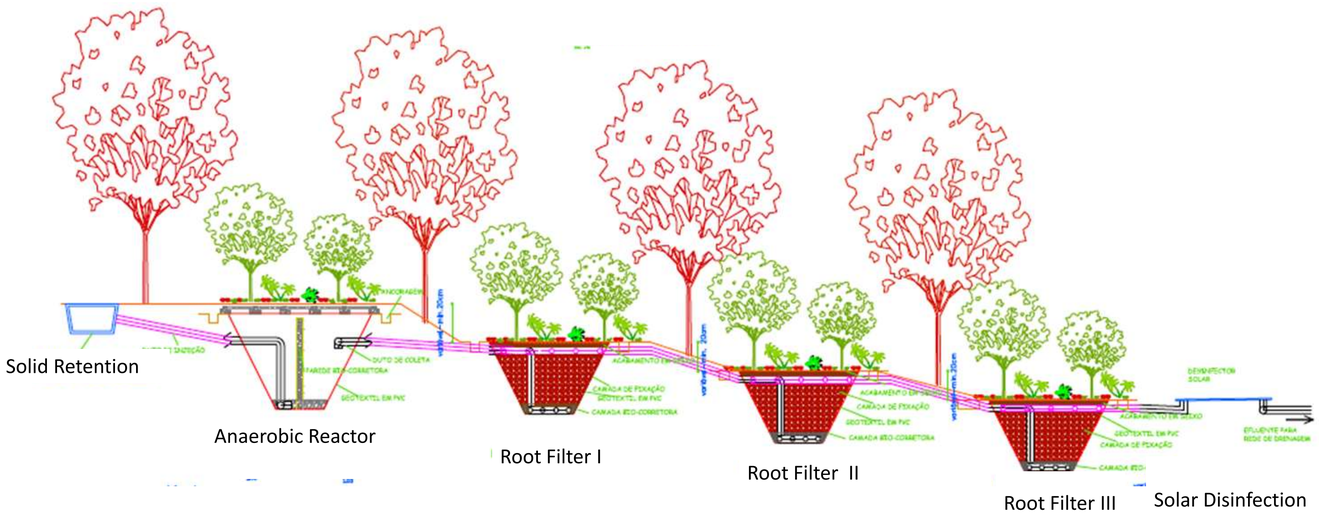

Fig. 3 Hydraulic profile of an ecological wastewater treatment plant (EWTP).

Fig. 4 *Pseudobombax munguba* in nature and in root filter of EWTP.

Fig. 5 Solar disinfection with bacterial colonies.

Fig. 6 *Pseudobombax munguba* in root filter of EWTP.

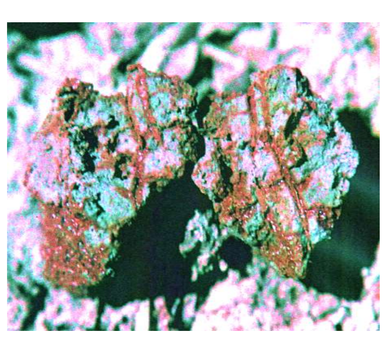

Fig. 7 Iron oxides along root.

Fig. 8 Iron oxidizing bacteria for disinfection.

The EWTP (Fig.3) is a copy of the natural hyporrheic interstitial process seen in flooded-forests. The tree-species *Pseudobombax munguba* (Fig. 4 and 6) liberates oxygen along its roots (Rätsch & Haase, 2007), forming iron oxide in its root tubes (Fig. 7). The periphyton on the roots mineralizes the solubilized products from the anaerobic primary treatment. Finally, we developed a solar disinfection (Fig. 5), as a transparent chamber with prisoned iron oxidizing bacteria (Fig. 5 and 8), leading to clean effluent (Fig. 9) and positive results of BOD < 50mg/l.

References:

- BMZ, 2011, Entwicklung braucht nachhaltige Energie, http://www.bmz.de/de/was_wir_machen/themen/energie/hintergrund/index.html, 24.06.2011
- Rätsch G. and Haase K. Anatomic prerequisites for internal root aeration of three tree species of the Amazonian inundation forest: AMAZONIANA XIX (3/4): 185-198. Kiel 2007.

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Fig. 9 Result: Clear water, ready to be used for agronomic fertigation.