Thesis Project Portfolio

River Water Treatment in Chennai: Producing Drinking Water by Reverse Osmosis and Biocrude Oil by Hydrothermal Liquefaction

(Technical Report)

Exploring Effects of Public Perception in Jordan on Wastewater Treatment Technology Use

(STS Research Paper)

An Undergraduate Thesis

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Sociotechnical Synthesis

Introduction

Recent advances in water treatment technology have lowered the cost and increased efficiency of producing clean water, a natural resource vital to life. Wastewater treatment specifically is an exciting technology that produces clean water with several environmental benefits, including reducing water pollution, and increasing efficiency and water recovery. The following portfolio investigates two case studies of areas suffering from water shortages and the technological advancements in water technology that may provide a solution to the water shortage. The technical report describes a design for a water treatment plant that incorporates reverse osmosis, a well-defined water treatment technology, and hydrothermal liquefaction, a new technology that when incorporated into a wastewater treatment plant design produces valuable fuel from the waste streams. The science, technology, and society (STS) research paper, on the other hand, investigates the water technology used in Jordan. Specifically, the research question addressed is: how does the public perception of wastewater treatment in Jordan impact the potential technological solutions to the ongoing water crisis of this region? Both projects take into consideration the cultural context when investigating technological solutions for the area with an aim to show the benefit of the relationship between technology and society.

Capstone Summary

The technical capstone project is a design for a wastewater treatment plant to provide drinking water to the city of Chennai, India, while mitigating pollution. The feed of the plant is river water from the highly polluted Cooum river which runs through the city. This water will be purified using reverse osmosis, and the waste in the river will be turned into biofuel using a

hydrothermal liquefaction reaction. Waste in the river includes trash, industrial effluent, high levels of microbes, and traces of heavy metals. Untreated sewage from the city, which can be directly sourced from private sewage truckers at no cost, will be combined with the waste collected from the river to increase the biofuel output from hydrothermal liquefaction. Microfiltration and multistage reverse osmosis will be performed to eliminate dissolved solids from the river water. Subsequent UV treatment will kill any pathogenic organisms left to purify the water to India's drinking water standards. The hydrothermal liquefaction reaction is a new technology to create fuel from municipal waste, and the implementation of this technology is what makes this wastewater treatment plant unique to others. To carry out this reaction, a supercritical hydrothermal liquefaction reactor will be used to turn the biological waste into biocrude oil, char, water, and gases. These fuels will be directly burned to provide power to the energy intensive reverse osmosis system. The overall goal of this design is to produce 9,840,000 L/day of potable drinking water for the city's residents.

STS Research Summary

The focus of the STS research paper is the relationship between Jordanian society and water treatment methods in support of finding a culturally sensitive technological solution to Jordan's water crisis. Two frameworks, technological momentum and the social construction of technology (SCOT), will be used to answer the following research question: How does the public perception of wastewater treatment in Jordan impact the potential technological solutions to the ongoing water crisis of this region? The expected outcome of this research is that there is no one technological solution to Jordan's water crisis, however this solution must adhere to the social beliefs regarding water and wastewater treatment in order to be successful. Water treatment in

Jordan gives an excellent case study for how significant of an impact that the public perception of a technology has on the development of said technology. This research gives an important example of how engineering must respect the society for which a technology is being built in order for that technology to integrate into the society and be used successfully.

Conclusion

Both of these projects show the value in taking into account the local culture when designing water technology. The relationship between technology and its users has always been vital for the engineer to understand before designing a technology. By carrying out both the technical and STS projects simultaneously, the importance of this relationship was certainly emphasized. In Chennai, the society context allowed sewage to be directly bought from sewage truckers, as much of residential Chennai is not actually connected to the underground municipal sewage system. In Jordan, the development of water technologies must take into account the cultural values of Jordanian society, as past attempts have shown that without this consideration technological advancements have not gone forward. Chennai, India, and Jordan have very unique cultural contexts, and the impact they have on water technology is clear in both theoretical designs and historical examples. In this way, this portfolio is an example of the extent to which engineering should account for the societal context of its technology and the benefits for which this may bring.