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Research Article

ADVANCES IN WATER TREATMENT METHODS AND CONVERSION OF WASTEWATER TO IRRIGATION USING SOLAR PUMPS

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ABSTRACT
In many homes, multistoried buildings, industries waste water is being just let out in the drain. During the day's water crisis and energy crisis, it becomes a criminal waste to individual and the country. It also can be considered to be a global problem. Here it is proposed that the waste water from individual homes, number of flats in a building the industrial waste water can be collected in reasonable number of tanks. The collected water can be treated properly by waste water treatment plant .At the global level, the treatment of waste water is one of the key aspects of protecting water resources. It presents a dual public health and environmental protection challenge for emerging and developed countries. With proper treatment, recycled water can be used to flush toilets, to grow crops, to recharge ground water. Water recycling is the multiple use of water, usually sourced from waste water (or) storm water systems, treated to a standard appropriate for its intended use. With proper treatment, the water is pumped to another tank using solar powered pumps.

Keywords: *CSP, Black Water, Gray Water*

INTRODUCTION
Water is a fundamental part of life and being expensive product like energy. Apart from this day to day life use for drinking, irrigation and marine life, water is used for various applications. There are two main water sources, surface water and ground water. Surface water sources such as rivers, streams and seas. Streams are generally seasonal, depending on the size and tributaries, river water sources require reservoirs for water supply and irrigation purposes. Normally, surface waters require treatment for domestic water supply. Raw water storage is necessary if the water resource is not available year around. Although the demand for irrigation water is seasonal, it still requires large amounts of water and dams or ponds are mainly used for storage. Absolutely pure water is not found in nature. Once the pure water touches the ground, it picks up many organic and non organic chemicals, microorganisms and organisms as it make its way into streams and rivers. Contaminates from the grounds surface include municipal, industrial and agricultural wastes. Depending on the intended use, all of these contaminates need some kind of treatment. Generally, waste water requires a certain level of treatment before it can come into contact with the surface or with ground water. Similarly, domestic water should be clean and safe to drink. Depending on the source, domestic water requires some kind of treatment.

Gray Water Systems
Water is a scarce source (Water, 2012) and is looking for ways to use less of it in our homes. We need water to drink, for cooking, cleaning, flushing toilets. We can reuse water by capturing both rain water and gray water. Gray water is the water that goes down the drains in our bathrooms, sinks, showers tubes and washing machines. It is possible to clean and filter gray water and reuse it both inside our homes and for irrigation purposes. First we need to know the difference between gray water and black water. Black water is the water that comes from kitchen sinks, dish washers and toilets. Black water can't be reused in our homes until it is fully treated and sanitized in a sewage treatment plant, something that most of us don't have in our backyards. Gray water is easier to prepare for reuse, most commonly in indoor storage tanks designed just for this purpose. Installing gray water in our home requires two sets of drain lines, one for the gray water and one for the black water. All the black water goes into the sewage or septic tank, and rest goes into the gray water tank. Treatment is necessary to keep the water from getting toxic, and is done with chlorine, UV light or a combination of these and other methods. Treated Gray water can be

used to flush toilets; you need to have supply lines to each toilet that are separate from the regular water in the house if you are building a new house. Gray water can be used for underground or soaker hoses, but it shouldn't be used to supply sprinkler heads because it can spray nasty stuff in the air, referred to as "aerosolizing", that you could breathe in and make you sick. Filters can get clogged, pumps can break, chemicals can go out of balance and there are lots of complicated things that can go wrong with a gray system.

Urban Waste Water

Urban waste water treatment has received lesser attention as compared to 'Water supply & treatment'. Water scarcity coupled with the bursting seams of our cities and towns taken a toll on our health and environment. The sewage contamination of our lakes, rivers and domestic water bodies has taken menacing proportions and is being realized by leading organizations like World Bank. According to the World Bank, "the greatest challenge in the water and sanitation sector over the next two decades will be the implementation of low cost sewage treatment that will at the same time permit selective reuse of treated effluents for agricultural and industrial purposes (Green, 2012). The current urban waste water management system is a linear and closed-loop treatment system which is based on disposal. The traditional system needs to be transformed into a cyclical and sustainable urban waste water management system which is based on the conservation of water and nutrient resources. Huge loss of life-supporting resources is the result of failed organic waste water recovery.GA waste water management team is well-equipped to create a waste water management strategy that will result in the reduction of pathogens in surface and ground water to improve public health. In a developing urban society, the waste water generation is usually approximately 30-70 m^3 per person per year. In a developing urban society, the waste water generated would be sufficient to irrigate approximately 1500-3500 hectare. This urban epidemic needs to be tackled ecologically because of so many pressing issues that are afflicting our waste water management process.

- New immigrants to cities have low incomes and who cannot afford the municipal amenities for waste disposal and sanitary functions.
- In developing countries, approximately 300 million urban residents have no access to sanitation
- Approximately two-thirds of the population in the developing world has no hygienic means of disposing excreta and an even greater number lack adequate means of disposing of total waste water.
- It is an acceptable practice to discharge untreated sewage directly into the bodies of water.

Industrial Waste Water

Industrial development has always afflicted with the issue of residue disposal and is now accepted by all the bodies of knowledge that industrial effluents are one of the largest sources of water pollution and one with the most lethal composition of toxins. The most popular and widespread industrial pollutants includes;

- Asbestos: It is carcinogenic and its fibres can be inhaled and cause illnesses such as Asbestosis, Mesothelioma, Lung cancer, intestinal cancer and liver cancer.
- Lead: It is non-biodegradable and is hard to get rid of once it has permeated our environment. Lead is harmful as it can inhibit the action of bodily enzymes.
- Mercury: It is also non-biodegradable and mercury poisoning is a serious health hazard for humans and livestock.
- Nitrates, Phosphates: it is one of the most common components in fertilizers and once it is washed from the soil and into rivers and lakes. This cans eutrophication, which can be very problematic to marine environments.
- Sulphur: It is extremely harmful for algae and other marine life.
- Oils: Oil does not dissolve in water; instead it forms a thick layer on the water surface. This can stop marine plants receiving enough light for photosynthesis. It is also harmful for fish and marine birds.
- Petrochemicals: This is formed from gas or petrol and can toxic to marine life.

Industrial effluents are the major source of toxins for ground water (Green, 2012). Mega Industrial parks require and in-plant waste segregation and pretreatments in lieu of a traditional central treatment of the combined park's waste water. GA applies the most appropriate technologies and environmental engineering skills to complex waste water management through a comprehensive in-plant waste water management evaluation.

Waste Water Treatment

Water reflects the development of our societies. Increasing urbanization and new production and consumption methods in industrialized and developing countries are creating new challenges for the management of the water cycle. Waste water treatment forms part of these challenges. At the global level, the treatment of wastewater is one of the key aspects of protecting water resources. It presents a dual public health and environmental protection challenge for emerging and developed countries. In fact, the total amount of water on our planet and in its atmosphere is estimated at 1,400 trillion cubic meters. However, freshwater only accounts for 3% of this huge quantity. This means that water is a precious resource, especially as it not evenly distributed.

Over 1.8 billion people still have no access to drinking water (Kyle *et al.*, 2012), while over 2.5 billion have no access to adequate sanitation services (United Nations, 2010). Against this backdrop; the treatment of wastewater provides a genuine solution to two major challenges for the planet: protecting water resources, and sustainable access to water and sanitation services. The increase in the world's population and breakneck urbanization are resulting in the increasing scarcity of water resources. The world's population is increasing at a rate of around 80 million people per year, which is leading to an increase in the demand for freshwater of around 64 billion cubic meters per year (Hinrichsen and Upadhyay, 1997).

This demographic phenomenon is resulting in an ongoing increase in the amount of wastewater, and therefore in the risk that sanitation networks and treatment plants become saturated, which in turn gives rise to the risk of polluted water being discharged directly into the natural environment. At the same time, changes in our lifestyles, especially in developing countries, are leading to the appearance of emerging pollutants (pesticides and drug residues) in wastewater and rainwater, which make managing the water cycle and preserving water resources even more complex. We are seeing increasingly systematic pollution of water tables, and deterioration in the ecosystems of aquatic environments as a result of this diffuse pollution. Today, 39% of species are considered as threatened.

The combination of human activity and the pollution that it generates is putting constant pressure on freshwater resources, and that pressure is becoming more intense due to climate change. By 2030, it is estimated that 47% of the world's population will live in areas that suffer from severe water shortages (OECD (Organization for Economic Cooperation and Development), 2008). Population growth, which is concentrated in coastal regions where 18 of the world's 27 mega-cities are located, is therefore putting pressure on water resources.

How do we meet these new changes? Sanitation techniques are changing so as to deal with these new challenges, and are now turning the treatment of wastewater into a cutting-edge industry. Moreover, the environmental, social and regulatory background such as climate change, increasing urbanization, and strengthening of environmental regulations etc., are resulting in the emergence of new requirements, including the dynamic management of rainwater, automatic metering, a decrease in energy consumption, and integrated management of water resources etc. Suez environment is offering overall control of the water cycle, which ranges from technical studies to the construction of new infrastructure, and includes comprehensive management of major urban services and industrial facilities. Thus enabling Suez environment to design, build, commission and operate new-generation wastewater treatment plants, which are increasingly respectful of the environment and water resources.

Need for Waste Water Treatment

The basic function of waste water treatment plant (US Environmental Protection Agency Washington DC, 2004) is to speed up the natural processes by which water purifies itself. In earlier years, the natural treatment process in streams and lakes was adequate to perform basic waste water treatment. As our population and industry grew to their present size, increased levels of treatment prior to discharging domestic waste water became necessary.

Collection of Waste Water

The most common form of pollution control in the United States consists of a system of sewers and waste water treatment plants. The sewers collect municipal wastewater from homes, business and industries and deliver it to facilities for treatment before it is discharged to water bodies or land, or reused.

Centralized Collection

During the early days of our nation's history, people living in both the cities and the countryside used cesspits to dispose of domestic waste water. Cities began to install waste water collection systems in the late nineteenth century because of an increasing awareness of waterborne disease and the popularity of indoor plumbing and flushing toilets. The use of sewage collection systems brought dramatic improvements to public health, further encouraging the growth of metropolitan areas. In the year 2000 approximately 208 million people in the U.S were served by centralized collection systems.

Challenges Faced by Waste Water Treatment Professionals Today

- Many of the waste water treatment and collector facilities are now old and worn, and require further improvement, repair or replacement to maintain their useful life;
- The character and quality of contaminants presenting problems today are for more complex than those that presented challenges in the cost;
- Population growth is taxing many existing waste water treatment systems and creating a need for new plants;
- Farm runoff and increasing urbanization provide additional sources and controlled by waste water treatment; and
- One third at new development is served by decentralized systems (septic systems) as population migrates further from metropolitan areas.

Basic Water Treatment Processes

Physical Processes

Physical Processes were some of the earliest methods from waste water, usually by passing waste water through screens to remove debris and solids. In addition, solids that are heavier than water will settle out from waste water by gravity. Particles with entrapped air float to the top of water and also be removed.

These physical processes are employed in many modern waste water treatment facilities today.

Biological Processes

In nature, bacteria and other small organisms in water consume organic matter in sewage, turning it into new bacterial cells, carbon dioxide, and other by-products. The bacteria normally present in water must have oxygen to do their part in breaking down the sewage. In the 1920s, scientists observed that these natural processes could be contained and accelerated in systems to remove organic material from waste water. With the addition of oxygen to waste water, masses of micro organisms grew and rapidly metabolized organic pollutants. Any excess microbiological growth could be removed from the waste water by physical processes.

Chemical Processes

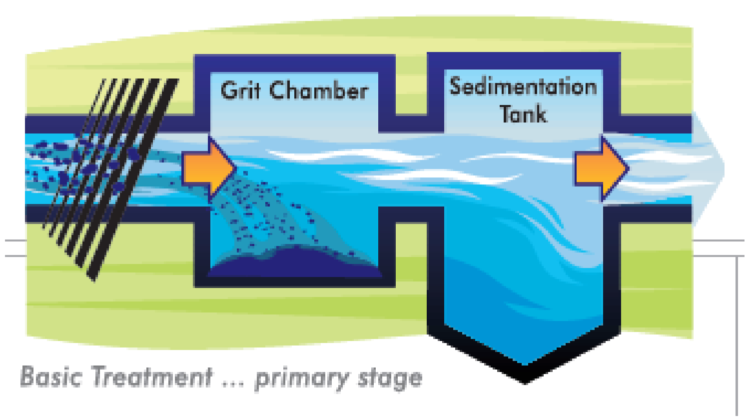

Figure 1: Basic Water Treatment Processes

Chemicals can be used to create changes in pollutants that increase the removal of these new forms by physical processes. Simple chemicals such as alum, lime or iron salts can be added to waste water to cause certain pollutants such as phosphorus to bunch together into large heavier masses which can be removed faster through physical processes. Over the past 30 years, the chemical industry has developed synthetic inert chemicals known as polymers to further improve the physical separation step in waste water treatment to improve the settling of excess microbiological growth or bio-solids.

Primary Sedimentation

With the screening completed and the grit removed, waste water will contains dissolved organic and inorganic constituents along with suspended solids. The suspended solids consists of minute particles of matter that can be removed from the waste water with further treatment such as sedimentation or gravity settling, chemical coagulation, or filtration. Pollutants that are dissolved or are very fine and remain suspended in the waste water are not removed effectively by gravity settling. When the waste water enters a sedimentation tank, it slows down and the suspended solids gradually sink to the bottom.

This mass of solids is called primary sludge. Various methods have been devised to remove primary sludge from the tanks. Newer plants have some type mechanical equipment to remove the settled solids continuously while others do so at intervals.

Secondary treatment

After the waste water has been through primary treatment processes, it flows into the next stage of treatment called secondary treatment. The secondary treatment processes can remove up to 90 percent of the organic matter in waste water by using biological processes. The two most common conventional methods used to achieve secondary treatment are attached growth processes and suspended growth processes.

Sustainable Treatment and Reuse of Waste Water

Water is one of the world's most valuable resources yet it is under constant threat due to climate changes and resulting drought, explosive population growth and waste (Seetharam and Santhosh, 2013). One of the promising efforts to stem the global water crisis is industrial and municipal water reclamation and reuse. The waste reuse association defines reused, recycled or reclaimed water as "water that is used more than one time before it passes back into the natural water cycle. Thus water recycling is the reuse of treated waste water for beneficial purposes such as agricultural and landscape irrigation, industrial processes toilet flushing or replenishing a ground water basis generally referred as ground water storage.

New Treatment Technology of Waste Water

Many countries have the problem of a severe water imbalance. This imbalance in water demand versus supply is due mainly to the relatively uneven distribution of precipitation, high temperatures, increased demands for irrigation, and the impacts of tourism. To alleviate water shortages, serious consideration must be given to waste water reclamation and reuse. Reclaimed waste water can be used for a number of options including agricultural irrigation. A waste water treatment developer must perform an appropriate risk assessment before implementing the reuse of waste water. Proper consideration of the health risks and quality restrictions must be a part of the assessment. Source-point measure require extensive industrial pre-treatment interventions, monitoring and control programs and incentives for the community to not dispose of any harmful matter into the sewers (World Bank, 2010).

For the implementation and promotion of new technology (Seetharam and Santhosh, 2013), strategies must include local participation as well as municipal action. Local participation is a positive and important growing trend in government projects. The participation must fit with the local population to meet particular local needs. Local communities can contribute valid indigenous ideas for cost savings in the project. Agreement on key issues between design engineers and the local residents is necessary early on in the project, and if local participation is extensive, capital costs can ultimately be reduced. According to the Inter-American Development bank, "Citizen Participation, properly channeled, generates savings, mobilizes financial and human resources, promotes equity and makes a decisive contribution to the strengthening of society and the democratic system". There is a strong sense of ownership by members of the community in their projects. This pride in the new development helps to ensure the sustainability of

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the water supply and sanitation systems. Once the project is impended, participation contributes to the community's confidence in the new technology and allows them to take on other challenges such as accessing financial aid for other infrastructure projects. On the governmental level, institutional strengthening is usually needed to assist small to medium-sized cities in dealing with new administrative and financial management responsibilities. One program that has been developed to address the problems associated with decentralization is RIADEL (Local Development Research and Action Network). It is a network for sharing information about local community in Latin America, including decentralization and the social leaders and civil servants.

Case Study of PERU

Peru's Ministry of Housing, Construction and Sanitation has approved a series of policy guidelines supporting the promotion of waste water reuse in the country for urban irrigation purposes. The guidelines are an outcome of the SWITCH project, co-ordinated globally by the IHE-UNESCO, and carried out in Peru by local organizations in collaboration with the Ministry of Housing. They build on existing small-scale private waste water treatment initiatives in the Lima area, and are intended to result in the scaling-up of waste water treatment reuse at a city and country level in order to make it a sustainable economic option (OECD (Organization for Economic Cooperation and Development), 2008). Whilst the initial scope will focus on the irrigation of urban green spaces(which lies within the Ministry of housing area of competence), it is expected that the next step could involve the reuse of treated effluent in agriculture with the potential to expand to other productive uses at a later date. The sector will play an important role in seizing the economic benefits of reusing of reusing treated waste water in other sectors beyond the irrigation of urban green spaces and agriculture. This will prove particularly important on the Peruvian coast, where there is a severe scarcity of fresh water resources. The most significant evidence of Peru's commitment to adopting waste water reuse on a large scale is pair of waste water treatment plants currently being established at Taboada and La Chira, which are designed to treat 100% of Lima's waste water flows by 2015. Together, the plants will create more than 2 million m^3/d of new capacity and will involve significant capital commitments (Fabiola, 2010) from the private sector. The policy guidelines focus on following five key elements.

- The inclusion of the reuse of treated waste water for the irrigation of green urban areas in national water resource management.
- The use of operationally and economically efficient treatment technologies;
- The facilitation of the participation of public and private sectors as well as of communities and international organizations in the investment and development of sustainable treatment and reuse systems;
- The promotion of citizens participation and access to information to ensure the transparency, control and efficiency of reuse systems management; and
- The strengthening of the capacity of the water sector in general in terms of treatment and reuse.

System Description

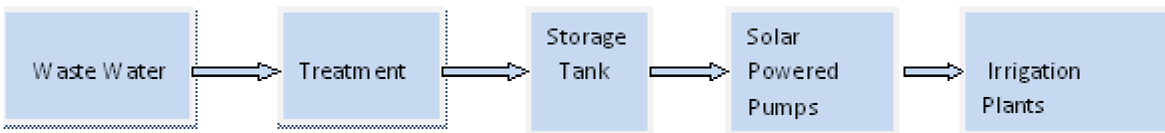

Figure 2: Block Diagram of conversion of waste water to irrigation

Solar powered systems are often considered for use in developing countries instead of other forms of other alternative energy because they are durable and exhibit long – term economic benefits. Solar powered water pumping is a good solution for grid isolated rural locations of solar radiation. Solar powered water pumping systems can provide drinking water without the need of any kind of fuel. Solar powered pumping systems is not adequate for large – scale irrigation but can work for small-scale irrigation purposes. Photovoltaic (PV) panels are often used for agricultural operations, especially in remote areas, or where the use of an alternative energy source is required. Solar water pumps may be especially useful in small scale or community based irrigation as large scale irrigation requires large volumes of water that in turn requires a large solar PV array. As the water is required during some parts of the year, a large PV array would provide excess energy that is not necessarily required, thus making the ayatem inefficient. The majority of the pumps are fitted with 200 watts to 3000 watts motor that receives energy from a 1800 W_p PV array. The large system can deliver about 140000 litres of water/day from a total head of 10 metres.

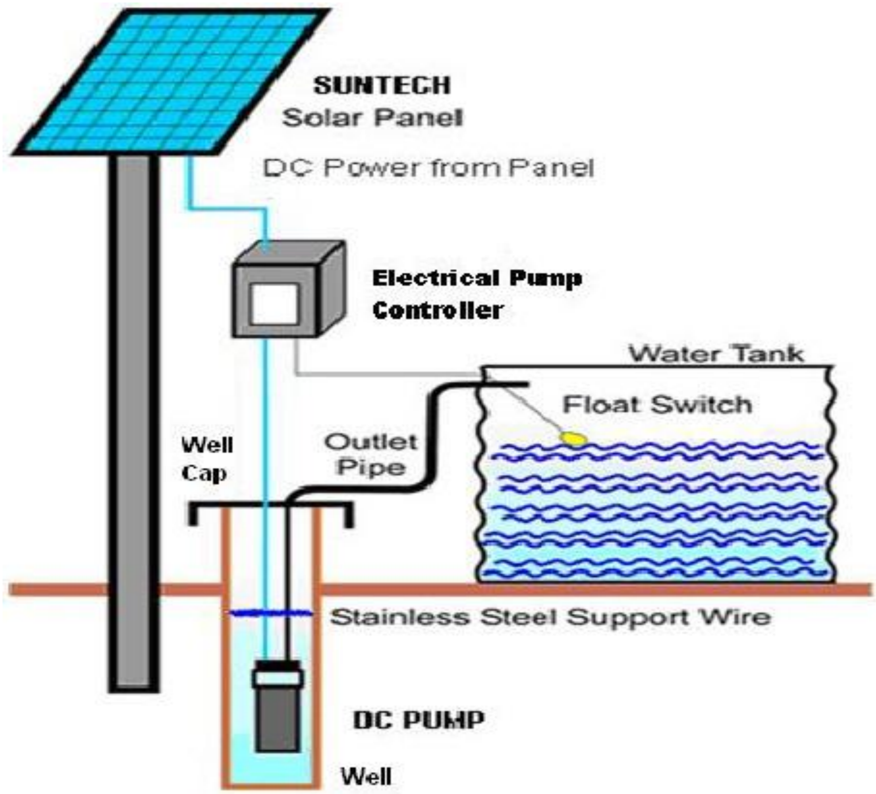

Figure 3: Solar Water Pumping Systems

A solar powered water pumping system is composed of several PV (photovoltaic) panels. Solar cells are the building block for solar panels. Each solar cell has two or more specially prepared layers of semiconducting material (generally silicon) that produce direct current (DC) electricity when exposed to sunlight. The DC current is collected by the wiring in the panel. This DC current is converted to AC current by using an inverter and this AC current is used to run an AC pump which pumps water whenever the sun shines and the excess water could be stored in an overhead water tank for the later usage.

CONCLUSION

Solar water pumps uses peak solar array output which frequently coincides with high water demand during long, dry summer days. In the cloudy weather days solar water pump systems often use solar tanks to store excess water. Solar pumps are cost effective and simple to install. The water for pumping undergoes various treatment methods and it has been reused. At the global level, the treatment of waste water is one of the key aspects of protecting water resources.

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