

A Review on Mechanical, Biological & Electro-Coagulation Treatment of Waste Water and Sewage

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Abstract- Water is one of the basic need for the survival of human beings on Earth. Nearly 70 percent of Earth's surface is covered by water, only 2.5 percent of it is fresh. It is painful to say but it is true that only 1 percent of freshwater is easily reachable and much of it is trapped in glaciers and snowfields. It is required for daily use like bathing, washing, cleaning and drinking and in many more applications. Harsh reality is that water is unevenly distributed and large no. of human communities have no easy access to fresh water, to fulfil their basic needs. Therefore, it should be used wisely and try to save every drop of it. As world's population is increasing day by day and more industries are being setup, rate of water pollution has also increased. In this paper an attempt has been made to sum up and conclude various works on treatment of wastewater from different perspectives. Various mechanical, biological and electro-coagulation methods have already been developed to treat wastewater. Every method works differently, with varying limitations and efficiency. This area still requires far more research, investment and development so that efficiency of proposed method is high.

Keywords- Waste Water, Water Treatment, Electro- Coagulation

I. INTRODUCTION

Ndubuisi C. Daniels [12] designed a machine which consisted of 3 major parts, the cleaner, the propeller and the pan. Best part of that machine was it did not depend upon electrical and chemical energy for energy requirements. Propeller generated energy through running water and it was very helpful when it rained cats and dogs, as it speed up the rotation of propeller. Experiments showed that when it rained heavily, garbage collection or efficiency was high. Pan was the third part which collected waste material into a safety trash can.

Bharadwaj S D Rahul and R Jogdhankar Shraddha [3] represented a wastewater treatment process. It was accomplished in 4 different stages. First stage was primary removal. In first stage suspended solid and floating solids were removed by screening circular roller and sedimentation. Second stage was secondary removal. It removed solids ranging between 0 inches to 4 inches. Third stage was tertiary removal, using oil absorbent cellulose material. Oil, grease and other light weight elements were screened off from drainage water. Fourth stage was secondary (biological) treatment. It removed dissolve organic matter that crossed primary treatment stage safely. It was performed by microbes consuming organic matter.

Tipayale Aman [23] designed "Smart Drainage Cleaning System". It aimed to substitute manual work by semi mechanical drain cleaner. He provided embedded programming system which can sense bin and report to cleaner. Through this technique there was an advantage for workers for managing their report through mobile phones and it was a heating step towards cleaning sewage automatically with less human intervention. It was the motivation towards digital and clean India and getting more and more digital and automated.

Prabhushankar N. *et al.* [15] designed a machine which used reciprocating pump as the main component instead of centrifugal pump for dewatering of drainages. As centrifugal pump was costlier and less effective in complete removal of suspended and heavy solids. They used pneumatic and spring system with reciprocating cylinder. There was use of pneumatic cylinder which used power of compressed air to produce linear motion with reciprocation. One component of pneumatic drainage system was spring return pneumatic cylinder. One drawback with it was less efficiency, as part of force produced by cylinder was lost as it tried to push against the spring.

Shinde S Harshal *et al.* [21] designed an automatic drainage cleaning system. According to them, at our hometown there were lots of sewage waste that contain many of harmful contaminants because of presence of many bottles, polythenes & cloth wood papers etc. Due to presence of these contaminants various diseases was germinated day by day. As N. prabhushankar *et al.* [15] designed a drainage discharge watering centrifugal pump, but that system was not effective to remove solid waste, bottles & polythenes. After that Shinde S Harshal *et al.* came up with an idea to make a system that could operate automatically and clean bottles and polythenes etc. They focused on gearing arrangement of drainage cleaning system. That system had consisted of DC motor, shaft, chain and sprocket. The frame materials were easily searchable.

Velia Sevil *et al.* [26] produced a paper which used chemical and electro-coagulation (EC) method for the removal of chemical oxygen demand (COD), total organic carbons (TOC) from municipal solid waste leachate (L1, L2). Biological treatment processes had proved to be insufficient as compare to that process for removal of persistent organics. In that method electrodes of aluminium and iron were used. The maximal removal reported was 87% for L1 solution, while for L2 was nearly 99%. Chemical reagents were

not used in EC method and this made leachate treatment easy for regulation and automation. In this study leachate was collected from the domestic waste lot of “Izmit Domestic and Industrial Solid Waste Landfill Plant”.

Karichappan Thirugnanasambandham *et al.* [7] did a research on optimization of electro coagulation process to treat grey wastewater. Method was examined under different working conditions such as initial PH (4-8), current density (10-30 mA/cm²), electrode distance (4-6 cm) and electrolysis time (5-25 min) by using stainless steel anode. To study process statistically pareto analysis of variance (ANOVA) and second order polynomial models were developed. Results showed that working variables had important effects on EC process. That process required more research so that it could treat grey wastewater with high efficiency.

T. Duricic *et al.* [22] investigated on removal of phosphate from synthetic wastewater by using electro coagulation method. Although phosphate was a precious nutrient but its high quantity causes eutrophication. Result showed decrement in phosphate removal rate with increase in its initial concentration and also by increasing electrolysis duration removal of phosphate increased. Experiments showed that aluminium electrode had higher removal efficiency (98.9%) compare to iron electrode (93.5%) for 40 minutes of treatment.

Prakash Anand *et al.* [14] developed microbial fuel cell to generate voltage from sewage sludge. Experiment showed that maximum voltage produced was 2.5V. MFC used biomass which was an alternative to fossil fuels, which according to study would be depleted in 40-50 years. MFC consisted of two chambers, one was anode and another cathode and they were separated by salt bridge membrane. In MFC microbe attacks organic matter and releases electron by acting as biocatalyst. Substrate concentration and ph. were two important factors that affected voltage generation. One advantage of using MFC over fossil fuel was that, it uses all kind of organic matter for its fuel. One limitation of MFC was that its efficiency was far from optimized.

Ghnainia Latfi *et al.* [5] presented an article on treatment of exploited water in petroleum activities by taking an example of ‘SEWAGE’ unit in the BG Tunisa Hannibal Plant. Samples had been taken out in July 2011 from Hannibal Treating plant which was investigated into HSSE department. There’s local deep well in the plant. However, before fulfilling requirements for gas process and domestic activities water was treated in metito unit to get it chemically fit for oil gas process and ensuring that it was satisfying health and environmental benchmarks. Various obstruction encountered by system during its execution were hydraulic overloading, high SVL, FM ratio, chemical pollution etc.

H Macarie [6] presented a paper which showed the importance of anaerobic digestion for wastewater treatment. Paper showed advantage of anaerobic treatment for problems, for which aerobic systems were inefficient. Earlier it was used only for treatment of food industry effluents. Today with advancement in technology it is widely used for treatment of sewage and effluents from other industrial activities. This was low cost process compare to other technologies but still large promotion was still required. It was a process in which organic matter was converted to CH₄ and CO₂. Nowadays, anaerobic digestion is believed to have reached technology maturity with at least 1330 low-and high rate reactors constructed in world.

Vasudevan Padma *et al.* [25] overviewed constructed wetlands for treatment of domestic waste water for reducing BOD, COD, NPK and pathogens up to a suitable level, so that treated water could be used for irrigation. Some dissolved chemical & solid waste could also be removed from that wastewater up to acceptable level. The wastewater released by industries could also be treated by CW method. That CW was mainly suitable for understanding role of microorganisms & macrophytes. But that method could be used after primary treatment as secondary and tertiary treatment of industrial waste water.

Narayanan T. Shankara and Balaganesh [10] came up with an idea to reduce the impurities or pollutants of waste water by using “Phragmites Roots” with the support of wetland concept. According to them pollutants & population were directly proportional to each other. According to Trivedy & Nakate in 2000 Indian Journal of Environmental Protection Pg. No.749 in India only 10% sewage was treated curely. Other sewages had got down on normal ecosystem & due to that waste water large scale pollution arose in rivers. It is known that wet land could remove impurities COD, BOD, Nitrogen etc. So they supported the concept of wetland system for treatment of water, as that concept was eco-friendly and had low maintenance cost. They used “Phragmites Roots”, as it could absorb the heavy metal solid waste in its roots.

Khatun A. & Amin M.R. [8] kept their attention towards the scarcity of water. Due to unplanned urbanization the population was increasing day by day. In order to fulfil their needs water was getting wasted. That water could not be used again, that water was known as grey water. A small scale research was done in Mosque to treat the grey water. That treated grey water could be utilized for irrigation, toilet, car washing & dust control etc. That project was running in Bangladesh.

Duryodhan N.S. *et al.* [24] transformed the automatic drainage cleaning system into pedal operated bicycle drain cleaner system. They modified the automatic drainage cleaning system due to absence of electricity in many villages. In bicycle when it had driven then due to rotary motion of pedal power was generated & that power was transformed into mechanical energy to drive the drainage cleaner. In that mechanism sprocket had connected with the help of shaft to the drainage with the bicycle system. That mechanism/machine could be driven by any person, means not much skill was required to drive that system. That system was also pollution free. That system was also very useful to power any small lighting device, by converting the mechanical energy into electrical energy with the help of dynamo.

Nithyavathy N *et al.* [13] modified the “Drainage Cleaning Machine” with the help of his group members. They kept their attention towards the health of municipal corporation workers. They proposed, “Remote Control Sewage Cleaning Machine”. They used RF transmitters and receivers, 9-volt battery and four channel relay board. In the previous system when the municipal corporation member had to clean the sewage they had to land into drainage, but in that modified version, they can control the machine speed and direction with the help of remote. Less skilled worker could easily handle that machine.

Nassiraei A.F. Amir *et al.* [11] designed an, “Autonomous Active Passive Intelligent KANTARO”, robot. For keeping attention inside the sewer pipe, the robot had a tendency to move and turning also, other commercial could only move at straight path in slow motion only. That robot was fully autonomous and could be controlled by mobiles. That robot consisted of intelligent modular architecture in its sensor and mechanism. They also transformed laser navigational landmark scanners. Following qualities were present in laser scanner: -

Table 1: Laser Navigation Landmark

Particulars	Magnitude
Scanning direction (degrees)	360
Scanning speed (rpm)	0-1800
Distance range (mm)	70-190
Accuracy (mm)	±1
Beam radius (mm)	0.5
Transmission method (MBPS)	Full duplex serial transmission
Sampling speed	More than 10KHz
Weight (gm)	200

Sharma Margank *et al.* [20] showed the importance of “Automatic Drainage Cleaning System Using Solar Panel” over the Manual Domestic Cleaning System. Drainage system at home contains lot of threats like dengue, malaria etc and sometime accident may also occur. To overcome all above problem, that system could be used for drainage cleaning system at a small scale. It worked in simple mechanism. The solar panel charge 12V DC battery which was connected to DC motor, which ran chain sprocket. By this means it can reduce maximum hazardous problem to human life and always the blocking free drainage system. It had some advantage like low cost, reduced threat to human life and also some disadvantage like rusting and jerk in chains also happened.

Ganesh UL & Vinod V Rampur [4] proposed a concept in which Manual Drainage Cleaning System was replaced by Mechanical Drain Cleaner. Semi-Automatic Drainage Cleaning System was introduced to reduce loss of human life while cleaning the blockage in the drainage system. Its mechanism was quite simple. Floating waste like bottles etc., were lifted by the lifters which was connected by chain. The chain revolved sprocket wheel which was driven by motor. Wastage was lifted by lifter teeth and collected to bin. The above mechanism helped to reduce flooding on a small scale. Its main advantage was that it was the cheapest way to fix the drainage problems and reduce accidents.

Vetrivel S. and R Puspavati [27] proposed a system to build a sewer robot which was capable of cleaning the blocks in sewer pipe of diameter from 80-100mm without employing humans. In that caterpillar type wheel system were engaged to increase the cleaning while vertical movement. That whole system was developed in low cost & inspection of pipe could be easily done with the help of “Sewer Robot using concept of Sensor Locomotives”. That whole system worked on instruction. Four bar chain mechanism were used so that it could expand and shrunk their wheel suspensions, together its own movement. By using some IR sensors and processors together along with locomotive, they could easily do inspection & cleaning action where the human hand could not reach easily.

Rana Kamal *et al.* [16] showed the importance of water and how to manage the grey water i.e. water from bathing, cloth washing could be used in maximum number of possible ways like toilet cleaning, floor washing and many more could be done to save fresh water for the future generation. The management of grey water was important because it restricted the use of fresh water and reduce stress on treatment system. In that research paper Rana Kamal *et al.* mentioned that how the grey water could be used again by basic two treatment processes.

Bates L. Julie *et al.* [2] fabricated an apparatus which removed the clog from domestic as well as industrial drain pipes. That apparatus could be used either in smaller diameter drain pipes like domestic sink where most of the cases of clogging occurs or could be used in large diameter for cleaning the blockage. That design contains a pressurising chamber and a shaft coupled with chamber, the shaft comprised of proximal end and distal end. The shaft had an interior surface sized for insertion into the drain pipe. The shaft in this apparatus was too flexible that it could be easily inserted into drain pipes. The pressurised fluid from the chamber entered into flexible shaft, cleaned the clog into drain pipe very easily.

Mateos A. Louis, & Vincze Marleus [9] invented the pipe cleaning mechanical system for DeWaLop robot i.e. Developing Water Loss Prevention. Its basic function was to clean the old drainage pipes of diameter (800-1000mm), without damaging the walls of the pipe. To do so the robot contained power tool, i.e. grinder on one of the arm and driving wheel located on the other arm. For damage prevention in the pipes, the mechanical system included the suspension system on double cylindrical arm to operate. It also provides stability and avoid jerk to the system.

Sawanya Laohaprapanon *et al.* [18] investigated the removal of organic pollutants from waste water using the wood fly ash as a low-cost sorbent. Under the certain testing conditions, it had been proved that the wood fly ash (WA) could be used as the alternative low-cost absorption medium from real industrial waste water instead of active charcoal. One condition was that when the WA is pre-treated with the hot water the Chemical Oxygen Demand (COD) efficiency increased from $37\pm.4\%$ to $42\pm1.6\%$ with the same dose when it was tested without treatment with hot water.

II. CONCLUSION

At last it can be concluded that there are various methods of cleaning the waste water & sewage either by the mechanical, biological or electro-coagulation method. Many researcher’s put their efforts to reuse the waste water by the different methods and technique and showed the importance of water in our life. In this review paper we summarised the researcher’s research so that any one going through it and can get the knowledge of the research that happened and also providing an idea for the future researchers.

[1] This review on mechanical projects depicts that how a simple mechanism can be used to clean domestic sewages so in order to reduce different diseases such as malaria, jaundice etc.

- [2] Apart from the mechanical technique, there are also many biological methods such as Reverse Osmosis methods and also with the help of different plants the heavy metals can be removed from the waste water or sewage water so that at least that water may get used in irrigation or cleaning purpose.
- [3] The grey water i.e. water from cleaning, bathing can also be used by some simple techniques so that we can conserve the drinking water.
- [4] In spite of mechanical, biological methods many researchers developed the pipe inspection and cleaning robot with the help of which that position where human cannot reach easily can be reached.

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