# HYDRAULLIC DESIGN OF PACKAGE SEWAGE TREATMENT PLANT USING M.S EXCEL-A Recent Review

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**Abstract –** *Considering the shortage of required spaces in urban areas for public utility projects like centralised sewage treatment plant, the policy of local Municipal Authorities to go for onsite treatment of sewage at the site of its generation itself is very popular and is considered to be the best solution from economy point of view and functional aspect. The Package type of sewage treatment Plants ranges from 1 KLD to 5000 KLD, use different technologies like Activated Sludge / Advanced Aeration, Bio film Reactor, Biological Aerated Filter (BAF), Moving Bed Reactor (MBR), Rotating Biological Contactor (RBC) and Sequential Batch Reactor (SBR). Whatever technology is used, the whole system is placed in a fabricated container, manufactured either onsite or in workshop and installed at the places where it is required. In absence of design procedure in Text book, an attempt is made to carry out hydraulic design of Package type of sewage treatment plant based on technology of SBR using M. S. excel as software tool.*

**Key words –** SBR Plant, Activated Sludge, Settled Sludge

## 1. INTRODUCTION

Rapid rate of urbanization, industrialization, and concentration of population towards cities ultimately reflect on higher demand of water for potable and non-potable use. The increase in water demand also increases sewage generation and is needed to be treated since all water bodies which were used to dispose of the sewage previously have already exhausted its potential of self-cleansing.

Sewage treatment is the process of removing contaminants from waste water, primarily from household sewage. Physical, chemical and biological processes are used to remove contaminants and produce treated wastewater that is safer for the environment. The treatment process has a series of process and operation units which are categorized under primary treatment, secondary treatment and tertiary treatment. While use of biological methods helps primary and secondary treatment of sewage at a moderate cost, the tertiary treatment incurs high expenditure. However, considering the huge quantum of sewage quantity for any urban city in India, the cost of collection of sewage and its centralized treatment is becoming inconvenient and costly day by day.

To overcome this difficulty Pollution Control Board has made it mandatory to provide decentralized sewage treatment plant known as package STP's for small town ships, hotels, restaurants in their premise. These zones comprise of high population density areas. The benefits of establishing decentralized Sewage Treatment plants (STPs or package plants) are reduction in transport cost, reduces soil pollution due to infiltration along with recycled water reuse opportunities for various purposes i.e., gardening, flushing, washing etc. The philosophy of decentralisation involves treatment of sewage close to where the sewage is created. Such Plants are also referred as, the Package wastewater treatment plant, which offers, user a pre-engineered and pre-fabricated method of treating wastewater with an aerobic process. The final effluent can be released safely into the environment such as receiving streams, rivers, etc.

## 2. LITERATURE REVIEW

1. **Samal, S.S.(2016)** has observed that the Pre-engineered modular components such as diffused air blowers, flow equalization tanks, aeration tanks, sludge holding tanks, wastewater clarifiers, and disinfection units allow for the package plants to be sized specifically for the customer's application. They can be designed to handle a variety of influent flow rates and BOD loadings to meet discharge requirements.

2. **Journal of environmental Management (2008),** has described as a way of emulating the nature emulating nature. A decentralized wastewater treatment system, commonly referred to as a "packaged plant", utilizes the biological extended aeration principle of operation, which is a variation of the activated sludge treatment process. This system functions by creating an environment with sufficient oxygen levels and agitation to allow for bio-oxidation of the wastes to suitable levels for discharge

However the details of design, operation and maintenance is not available easily since the manufacturers and all commercial establishment try to preserve the information with themselves. As such it has become necessary to develop design methodology for Package type sewage treatment Plant using Microsoft Excel as a tool.

3. **Garg, S.K.(1996)** in his book has mentioned that any sewage treatment takes place in four phases which include i) Preliminary treatment, Ii) Primary treatment, iii) Secondary treatment , iv) Tertiary treatment.

The Preliminary treatment Removes the biggies like plastic bottles, tree branches, rags, wrappers, solid, coarse objects and materials. The Primary treatment Occurs inside a sedimentation tank which settles to the bottom all the organic and inorganic solids while the grease, oil and lighter solids are moved to the surface using skimmers. This phase is expected to remove at least 60% of solids (mechanically scraped off and directed to sludge treatment) while the remaining water moves to the next stage. Secondary treatment Entails secondary clarifiers separating biological floc from the liquid with the use of aerobic biological processes (through managed indigenous microorganisms that consume biodegradable soluble contaminants). This stage is focused on intensive cleaning of water (up to 90%) after flotsam and solids are cleared in primary treatment.

4. **Butler Service Manufacturing (2001),**

Describes the sequential batch reactor(SBR) as one of the major process in which the multiple reactors are provide to treat the waste water in batches .Sequential batch reactors are operated to oxidize carbonations BOD ,nitrify the ammonia and denitrify to reduce total nitrogen to a level that meets the permissible limits. All treatment processes including equalization, aeration, Denitrification and sedimentation occurs in SBR eliminating the need for separate clarification and return activated sludge system.

**5. M. Aswathy et al.(2017),** studied on analysis and design of sewage treatment plant of apartment in Chennai. This project is studied that domestic and commercial waste and removes the material with possess harm from generated public. To produce an environmental sewage fluid waste stream and solid waste suitable from disposal of use.

**6. S. Ramya et al.(2015),** reviewed on design of sewage treatment plant and characteristics of sewage. The growing environmental pollution need for decontaminating water results in the study of characterization of waste water especially domestic sewage. The waste water leads to developing and implementing treatment techniques to control nitrogen and other priority pollutants.

**3. MATERIAL AND METHODOLOGY-**In order to understand intrinsic of different type of hydraulic design of STP and carried out hydraulic design of STP BY SBR METHOD 150 KLD following details were find out-

## 4. DESIGN DETAILS-

### 4.1 Bar Screen Chamber-

Max Flow = 150 KLD = 150 $m^3$/day = 0.104 $m^3$/min

Bar screen chamber volume = 0.624 $m^3$/min

BSC size =1 m ×1m size of chamber (area = 1.0 m2) × 1 m (swd)

Screen is made out of MS Flat of Size 10mm x 50mm (10mm facing the flow)

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Spacing-20mm

### 4.2. Equalization Tank:

Design average flow =150 KLD = 150 $m^3$/hr

Volume of Equalization tank = 75 $m^3$

Equalization tank dimension = 5.0m × 5.0 m × 1.2 m

### 4.3. Bio Reactor:

Bio Reactor volume, V= **68.83 $m^3$ with 3.5mas SWD, Area = 22.94 $m^2$**

Each bio reactor dimension = **5 m ×5 m× 3.0m**

### 4.4. Decant Tank:

Considering 3.0 m as

SWD and area = 50 $m^2$, the clarified water tank dimension are kept as = 7.1**m × 7.1 m × 3.0m**

### 4.5. Sludge Holding Tank:

Reactor volume =12 m3

MLSS =4000 mg/ L

Sludge holding tank dimension=**2.0m× 2.0m**

**×3.5m**

**4.6. Mechanical filter press : 34 chambers**

Dimension : 0.61m × 0.61m

**4.7. Activated carbon filter :**

Considering the same parameters for designing the activated carbon filter, the recommended Dimension for ACF is 1.3 m dia and height 3.0 m

**4.8. Pre aeration tank:**

Detention time= 4Hr

Volume of final collection tank = 2

Final collection tank dimension =3m ×3m ×3.5 m

**4.8. Final collection Tank:**

Detention time =11.5 Hrs

Volume of final collection tank = (150 x 11.5)/24 = 71.87 m3

Final collection tank dimension =4.9 m ×4.9 m ×3.0 m(SWD)

## 5. RESULTS AND DISCUSSIONS

All popular methods of aerobic biodegradation like Activated sludge process including extended aeration, MBBR, BAF, MBR, RBC and SBR are studied in depth. Every process has its pros and cons and may prove advantageous over one another especially in case these are used for Package type of sewage treatment Plant. However it is observed at the end of this study that the SBR process commands preferential position among selection of process for making Package type of treatment plant. These results are enumerated below.

i) A sequencing batch reactor (SBR) aeration system differs from an activated sludge process as regards the system that uses one tank for all the treatment steps, rather than using different equipment for each step in the process. The system was originated in USA in 2014 but is still widely practiced in India till this date.

ii) SBR system design follows timed sequence to accomplish sub-processes such as equalization, aeration and sedimentation all in the same tank.

iii) The whole SBR process takes place through a set cycle that typically consists of multiple steps viz. filling up the tank with effluent, aeration for microorganism to flourish, to begin biological reaction, clarification to settle down the solids in the same tank.

iv)Unlike ASP/Extended aeration, this process does not require separate tank for clarification bu happens in the same tank served as reactor.

iii) SBR operations takes place through a set cycle that typically consists of five steps. First in the SBR process, an operator will fill the tank with influent. Next, aeration and microorganisms begin to facilitate a biological reaction. After this step concludes, clarification takes place, meaning the sludge begins to settle. Typically, this process would take place in a different tank, but with SBR, it happens in the same tank that served as a reactor for the biological process.

iv) In the end, the process is termed as idle, since after reaching this stage the new lot of influent is introduced in the tank and once again the whole operations are repeated.

v) SBR system of aeration uses a broader framework for wastewater treatment. Although in some cases the grit removal or disinfection is followed at the pre-stage or post stag treatment, in many cases, SBR alone may work as the sole means of treating wastewater, depending on the quality of the influent and the desired quality of effluent.

vi) SBR can adapt to fluctuating volumes of influents with automated control over processes and can be hoisted in less space as compared to conventional ASP process.

## 6. CONCLUSION

The Package type of sewage treatment plant (STP) using SBR tecnology can be the most desired choice of the engineer dealing with water supply and sewage treatment. The sofastcation of the system although cost prohibitive is prferred in sewage treatment especially in Municpal areas . The use of software can further enhance the sofastication of the SBR system for optimumutilisation and effective sewage treatment

## 7. REFERENCES

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