SOLUTION FOR PRESENT WATER CRISIS BY SEWAGE RECYCLE BY ADVANCED SBR TECHNOLOGY AT LOWER O & M COST WHICH MAKE ULBs SELF SUPPORTING

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INTRODUCTION:

Water is the lifeline of all living beings. All human settlements on earth are developed near the source of water. Even though two thirds of earth is covered with water, only a small fraction of total water is actually usable by mankind. As the population and industrialization is increasing, demand for water is also increasing. This is exerting more stress on the existing water resources. With changes in climatic conditions, and steadily declining rainfall in many areas, the problem is further aggravated. Many major cities in India are under severe scarcity of water. The stress on water resources results from an imbalance between the consumption of water and the available water resources. The time has come to understand the root cause of the problem and address the impending threat of a water crisis which jeopardizes the existence of millions of people around the world. A catastrophic water shortage could prove the biggest threat to mankind in coming years. If we value our own futures on this planet, we should sit up and take notice of the many ways we can conserve water and live in a way that does not pose a danger to the delicate natural climatic processes of the earth.

First and foremost thing to do for reducing the water crisis is "Water Conservation". Everyone has to stop wasteful and luxurious use of water and start using it judiciously. Next possible activity is to find out alternative sources of water like Rainwater harvesting, Desalination of sea water, etc. In addition to this, there is one more unconventional source of water, "SEWAGE".

Sewage is seen as an alternate source of water supply when treated with modern treatment technologies. Sewage treatment and its safe disposal are necessary anyway for protecting our valuable water sources and also to check pollution and spread of deceases. A little additional cost and little care in operating sewage treatment plants can add to available water resources. Sewage recycle is most economical and viable solution when compared to other alternative sources of water such as sea water desalination. As the sewage is available right in the center of human settlements, its transportation costs are minimum reducing overall cost of the scheme.

Various technology options have been implemented in India for treatment of domestic Sewage. However conventional technologies have not been able to solve the problems as they are unable to remove some of the pollutants present in sewage (such as Nitrogen & Phosphorous) and can only remove others to certain levels. The pollution Control boards had earlier issued treatment guidelines, which were mainly based on the capacity and the cost effectiveness of available technologies to do the job of meeting disposal standards. As the sewage recycle is becoming a practice now, treatment objective is much beyond meeting disposal standards.

SBR - A SUCCESS STORY IN SEWAGE RECYCLE:

However with the development of technologies like Cyclic Activated Sludge process (SBR), it is now possible to completely treat all the contaminants in the Sewage. SBR has many

advantages over conventional treatment processes. The treated water out of SBR is crystal clear with BOD values less than 5 ppm and suspended solids lower than 10 ppm. The treated water can be used for agriculture, gardening, industrial applications, etc. Other advantages include lower power consumption, lower area requirement, automatic plant operation, simultaneous nitrification & denitrification, compact design, flexible operation, etc.

SBR success story in Indian Government segment started with its first plant at PWD- Goa in 2005. Till now 16 plants are commissioned producing recyclable quality water of approximately 500 MLD. Another 60 plants are under various stages of construction. Once all the plants are ready, a total amount of over 2800 MLD of treated wastewater can be made available for various non potable uses like industrial, gardening, washing, agriculture, etc. 2800 MLD of water can nearly meet requirement of Mumbai city or can meet water requirement of 40 towns with a population of 5, 00,000 persons or can supply water to 2 crore people. This is a huge amount and if managed properly, it can certainly make an impact on the water situation in cities.

Many municipalities are adopting this technology for the above benefits as well as to protect the environment from further damage from outdated technologies.

SBR - A NOVEL TECHNOLOGY FOR SEWAGE TREATMENT & RECYCLE:

SBR is a Cyclic Activated Sludge process technology which is an advanced form of Sequential Batch Reactor (SBR) process. SBR methodology is very commonly used for scientific studies, bench scale testing, and full scale applications of mainly small and medium size plants worldwide. The Cyclic Activated Sludge process Technologies represent a certain technical development of a process philosophy (Goronszy 1979, 1985, Demoulin et al 1997, 1999). This process family is applied in large scale treatment throughout Germany, England, North America, parts of Asia and Australia. Development of following process methodologies lead to development of SBR:

* Process control using in-basin respiration rates, which allowed permanent control of the metabolic activity of the biomass and consequently changed the principles of process operation from a time based control to a demand oriented process control.
* A clear water withdrawal system for high rate decanting of up to 2.5 m of solids free effluent within a short time from basins having surface areas of up to 8000 sqm (i.e. multiple basins and multiple decanters).
* Establishment of adjustable normal and high flow operating protocols.

The above mentioned developments were commenced in Australia and later adapted and developed for North America climates and extended to meet local climate and discharge requirements of Central Europe and Asia including India. Cold climate co-current nitrification/ denitrification and redox controlled EBPR were demonstrated in the Austrian Grossarl plant, (Demoulin et al, 1997), in 1994 for the first time in Europe. The first such plants to use this technology in Germany are the Potsdam (FRG, 90,000 pe) and Neubrandenburg (FRG, 140,000 pe) facilities (Demoulin et al, 1999) which came online in early 1999.

The SBR - System specifically refers to the use of variable volume treatment in combination with a biological SELECTOR and OXYGEN UPTAKE RATE (OUR) control, which is operated in a fed-batch reactor mode.

The following process components as can be seen in Figure I are part of the technology:

* Biological SELECTOR on the front end of the reactor with sludge recycle from the main aeration part to suppress bulking / foaming and allow co-current nitrification / denitrification (N/DN) and Bio-P
* Special constructed high rate DECANTER to withdraw solids- and scum-free treated effluent from the basins
* OUR (OXYGEN UPTAKE RATE) control to regulate aeration intensity according to actual demands of the process.
* Co Current Nitrification and De nitrification, Phosphorous removal provides Nitrogen and Phosphorous removal to remove nutrients making the water safe for water discharge
* Decanter assembly in Stainless steel equipped with VFD to automatically control rate of decanting based on input feed condition. Ensures no corrosion, long equipment life, no maintenance
* Diffusers for highest aeration and oxygen transfer efficiency
* Return sludge (RAS) recycle and Surplus sludge (SAS) pumps for sludge wasting from reactor. No secondary clarifier is used which drastically reduces civil cost and construction cost
* PLC unit for complete automatic cycle control and operation. Reduces manpower cost. Complete operation can be hooked to central control desk.

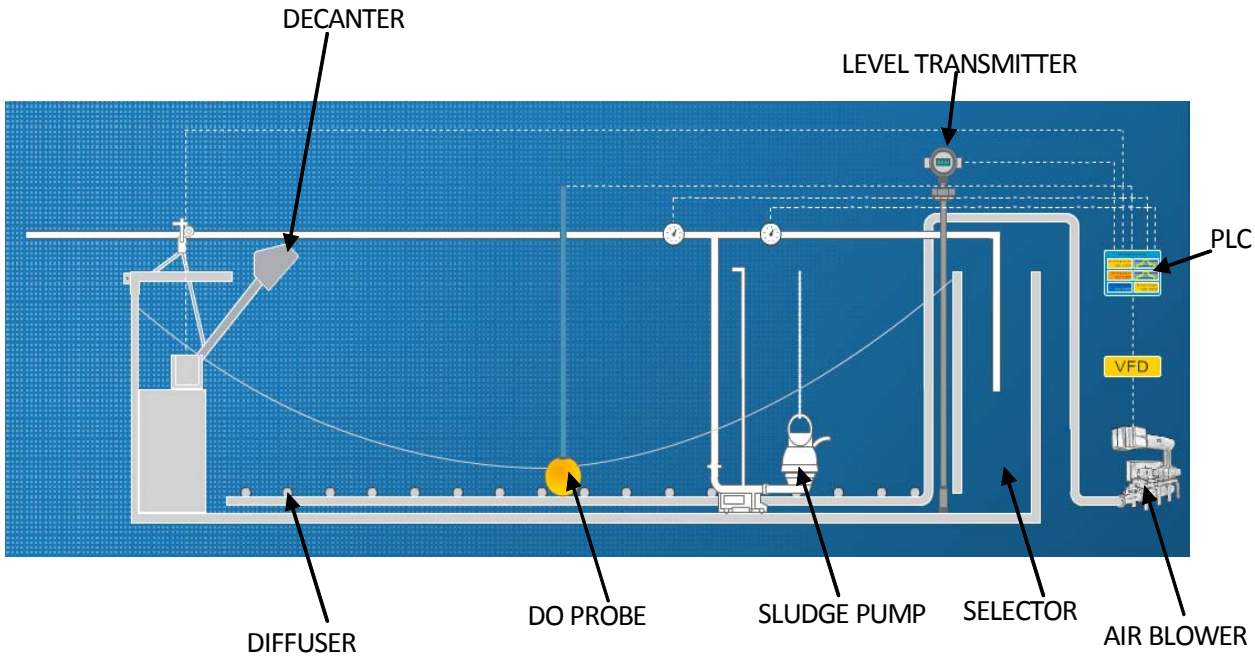


Fig. I: Typical Components of SBR Technology

A basic cycle of SBR comprises of:

* Fill-aeration (F/A)
* Settlement (S)
* Decanting (D)

During the period of a cycle, the liquid volume inside the tank increases from a set minimum operating bottom water level. Aeration ends at a predetermined period of the cycle to allow the biomass to flocculate and settle under quiescent conditions. After a specific settling period the treated supernatant is removed (decanted), using a moving weir DECANTER. The liquid level in the vessel is so returned to the bottom water level after which the cycle is repeated. Solids are wasted from the tanks during the decanting phase. These phases in a sequence constitutes a cycle

Which is then repeated as shown in figure II.

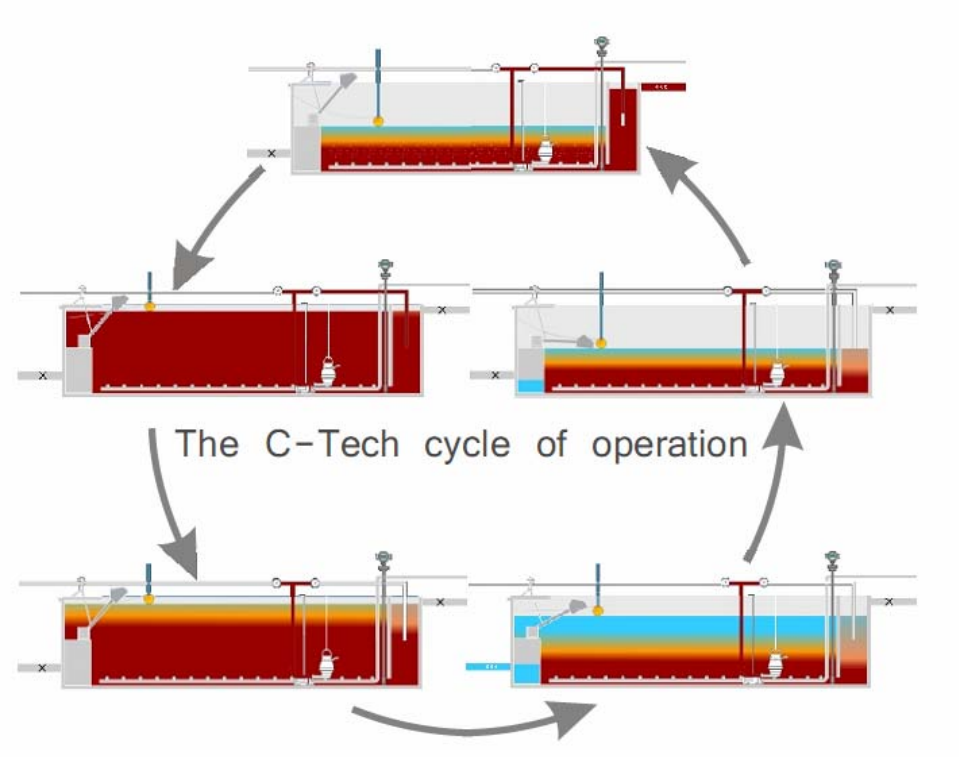


Figure II: Cyclic Operation of SBR System

The cycle continues in each basin of the SBR system. For continuous feed into the system, it requires minimum of two basins.

The selector is designed to allow maintenance or variation to oxic, anoxic, anaerobic retention time components. The mixed conditions at the inlet of each selector associate with a very high potential (maximum) oxygen utilization rate (POUR) Goronszy et. al., (1986) which is typically in excess of four times the specific oxygen utilization rate (SOUR) in the main reactor volume. The sludge flow to the selector is typically less than 30 percent of design average dry weather flow (in comparison to 300 - 400 percent of total return flows in conventional systems). A selective growth pressure against filamentous microorganisms, such as

Microthrix p, is maintained in favor of floc forming microorganisms. This feature provides considerable enhancement to the settling properties of the biomass as demonstrated during the start up of the Neubrandenburg plant in which a bulking seed sludge was used (Demoulin et al, 1999). No mechanical mixing devices are used as baffled walls are properly placed to provide the necessary mixing, solids entrainment and floc-formation velocities in the selector. The primary process mechanism taking place in the selector relates to enzymatic transfer of readily degradable soluble organic substrates into the biomass (viz. biosorption). By design, phosphorus release occurs in the selector with only minimal denitrification taking place.

A balanced process is achieved and regulated by online-measuring of the specific oxygen uptake rate in the basin in such a way that the floc reaction profile allows for nitrification at the peripheral sections and denitrification at the inner parts of the floc as shown in Figure III.

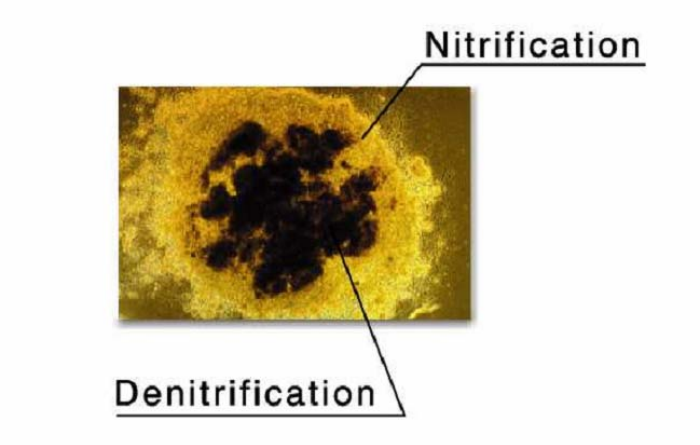


Fig. III: Representative view of a sludge floc under a light microscope with suggested zones for co-N/DN

Nitrate penetration is governed by its rate of diffusion which is of the order of ten times that of dissolved oxygen. Under aerated conditions there is typically no nitrate limitation in the interior zone of the floc. Sufficient carbon provision for denitrification is achieved through the carbon storage (biosorption) mechanism and the proportional DO demand regulation which minimizes the use of substrate carbon by oxic metabolization. Under extreme conditions, e.g. long-lasting low temperatures with high total nitrogen concentration in the influent, the process can be regulated such that during the aeration phase there is nitrification and also also denitrification taking place within the flocs. Denitrification also takes place during settling phase. Rising of activated sludge due to nitrogen gas bubbling does not occur as during the relatively short time cycles only low concentrations of nitrate nitrogen have to be denitrified in each cycle.

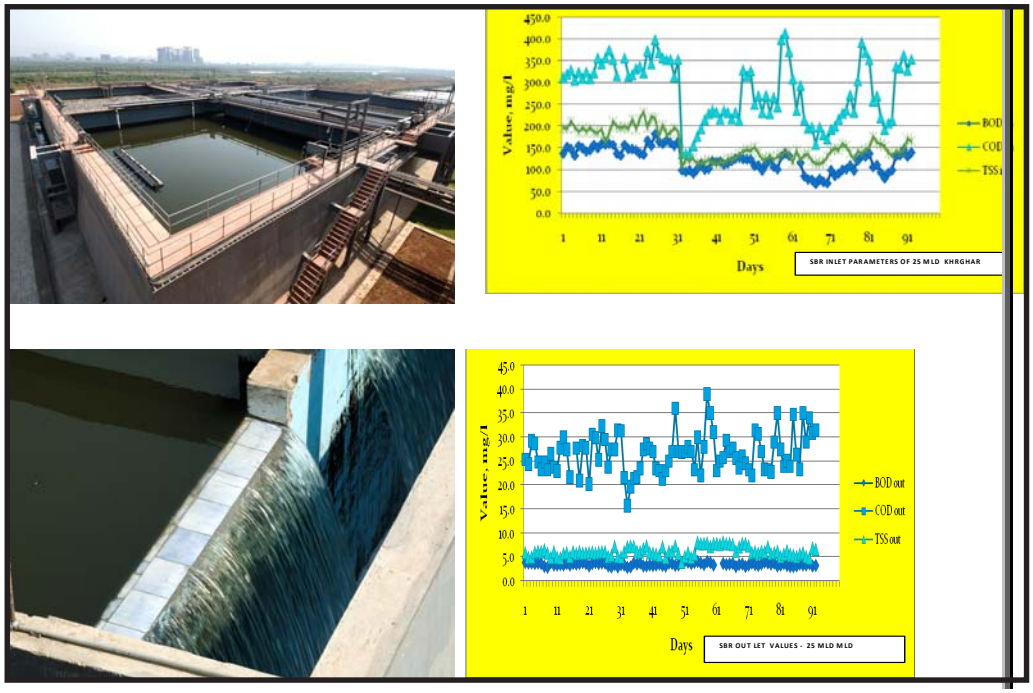
Process control using in-basin respiration enables a direct control over biological phosphorus removal. Operating data shows much less than stoichiometric precipitant addition is required to arrive at concentrations of less than 0.5 mgTP/l without tertiary filtration.

FEW CASE STUDIES OF SBR IN INDIAN MUNICIPAL SEGMENT:

CIDCO -Kharghar, Navi Mumbai:

Capacity of plant : 25 MLD

Year of commissioning : 2008

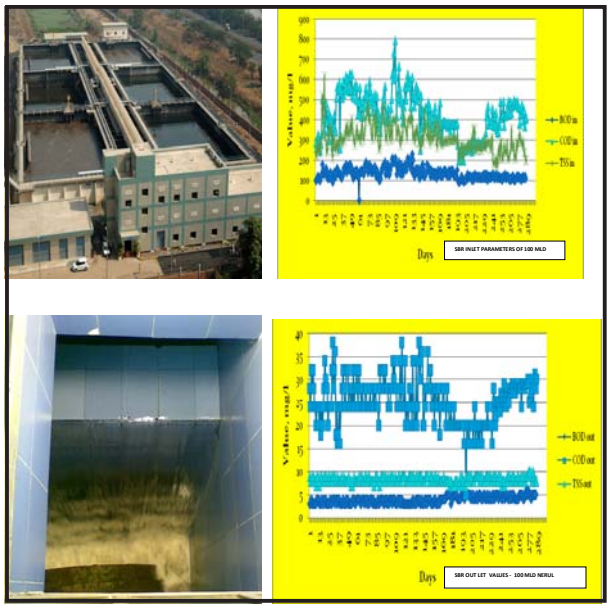


The plant is producing consistently good quality of treated sewage with BOD < 5 mg/l and suspended solids less than 10 mg/l. At present 50% of the treated water is being used in central park thereby saving 12.5 MLD of municipal water. CIDCO is in the process of identifying various industrial users for the remaining portion of water from this plant and for the treated sewage from other SBR plants in Navi Mumbai.

Nerul, Navi Mumbai Municipal Corporation:

Capacity of plant : 100 MLD

Year of commissioning : 2008

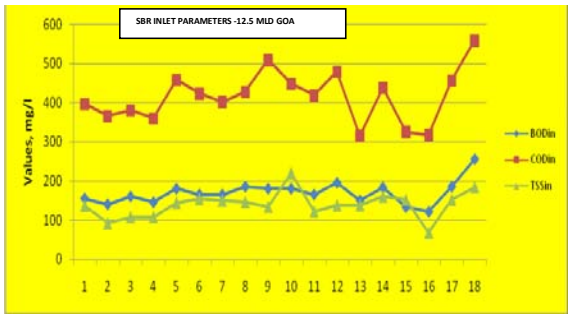


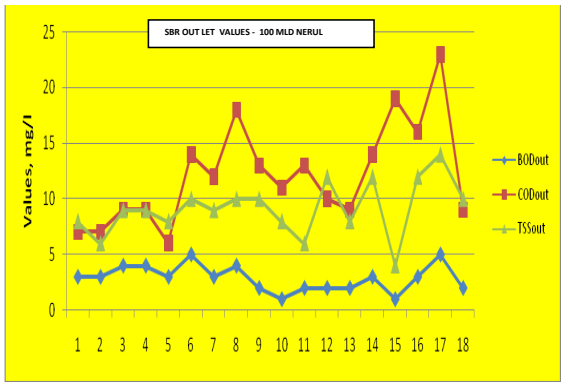
The plant is producing consistently good quality of treated sewage with BOD < 5 mg/l and suspended solids less than 10 mg/l as shown in graphs. At present portion of the treated water is being used in adjacent housing complex for gardening. Municipal Corporation is in the process of identifying agency for sale of treated sewage for industrial use, thus making the sewage treatment a source of water and revenue generator for the corporation.

PWD Panjim, Goa:

Capacity of plant : 12.5 MLD

Year of commissioning : 2005





The plant is producing consistently good quality of treated sewage with BOD < 5 mg/l and suspended solids less than 10 mg/l. At present treated sewage water is being carried through tankers for gardening and green belt development. Proposal for laying out permanent pipe line for transporting treated sewage to usage points is under consideration.

All other plants commissioned so far in India are producing excellent quality of treated water making the sewage treatment plants as sources of water and revenue generators for corporations. This new trend of sewage treatment is helping to ease out water problems to some extent.

CONCLUSION:

* Cyclic Activated Sludge Process /SBR Technology -the most improved version of Conventional Activated Sludge Process which eliminates the limitations of the conventional activated sludge process.
* Cyclic Activated Sludge Technology (SBR) is the most advanced and efficient process of biological treatment of wastewater for the removal of organic pollutants including nutrient removal.
* Performance of STPs based on SBR generates treated sewage of quality with BOD < 5 mg/l and TSS < 10 mg/l along with nutrient removal at lower power Consumption, consumes lesser space, less manpower, lesser maintenance, in nutshell overall O & M cost will be less than the conventional ASP even with generating above treated quality without any tertiary treatment.
* Widely accepted in Indian Government Organizations/Municipal Segments from 1 MLD to 245 MLD capacities under various central & abroad funding like JnnRUM, UIDSSMT, NRCD, NLCP, WORLD BANK, ADB, JICA etc.
* Well accepted by Indian Institution of Technology (IIT), NERI etc.
* The treated effluent from the SBR plant can be used directly for various non potable applications such as industrial, cooling water, toilet flushing, gardening, vehicle wash, etc.
* Such technology base plants are "ECO-FRENDLY", "ODORLESS" & NUICENSLESS in true manner so it can be constructed near any residential /commercial complex places of the cities/ ULBs which prevents the land revenue loss of the local body.
* Such technology base plant operation is controlled automatically through a PLC system and facilitate with remote monitoring system hence performance of the plant can be seen or reviewed from anywhere/places by the key administrative staff for correct monitoring of the plant.
* Such technology base plants will become asset of the cities/ULB in very near future because it will not just meet the future environmental threatens but also help out the drinking water problems of the cities/ULBs by providing treated water for non-potable applications. Urban Local Bodies/Cities can earn the revenue by operating the plant on PPP modality which will make them self supporting by generating revenue from sale of excellent treated water and manure.

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