Review paper on decentralized wastewater treatment system

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***Abstract*—Provide a reliable and affordable wastewater treatment is a challenge while Centralized wastewater collection and treatment systems are costly to build and operate, especially in areas with low population densities and dispersed households. Developing countries lack both the funding to construct centralized facilities and the technical expertise to manage and operate them. Alternatively, decentralized approach for wastewater treatment (DEWATS) provides better option for wastewater treatment. The decentralized system allows combination of various low cost treatments. This paper presents an approach of decentralized wastewater treatment system.**

Keywords— Decentralised, Wastewater, Anaerobic treatment

I. INTRODUCTION

Water is the essential basis for all forms of life. Water is of utmost importance for human health and dignity. In the past 250 years the world has seen a tremendous increase both in population and economic activities. This development process has resulted in extensive social transformation and a rapidly increasing demand for natural resources. Urbanization, industrial development and the extension of agricultural production have a significant impact on the quantity and quality of water resources. [2] As cities grow and water supply systems extend, more wastewater is produced Much of this wastewater includes black water, created when water is used to flush fecal solids, and threatens the environment and, if used without treatment it affect health of consumers, especially poor people.[1]

Significant development has been made in wastewater treatment for urban areas as compared to rural areas. In urban areas centralized systems of sewerage networks are provided for treatment and disposal of wastewater. These treatment plants are associated with major investments due to high capital cost in addition to operation and maintenance cost. Conventional technologies of wastewater collection and treatment are natural resource intensive, but also capital and energy intensive. Restricted local budgets, lack of local expertise, and lack of funding, result in inadequate operation of wastewater treatment plants in developing countries. [5]

Collection, treatment and disposal are three basic components of any wastewater management system of which collection is the least important for treatment and disposal of wastewater. Nonetheless, collection costs more than 60 percent of the total budget for wastewater management in a centralized system, particularly in small communities with low population densities. [3].

II. WASTEWATER TREATMENT APPROACHES

Wastewater treatment approaches vary from the conventional centralized systems to the entirely onsite decentralized and cluster systems. The centralized systems which are usually publicly owned collect and treat large volumes of wastewater for entire large communities, thus making use of large pipes, major excavations and manholes for access. On the other hand, decentralized onsite systems treat wastewater of individual homes and buildings. While decentralized systems collect, treat and reuse/dispose treated wastewater at or near the generation point, centralized systems often reuse/dispose far from the generation point. Cluster systems, which can be either centralized or decentralized, serve more than a single household reaching up to 100 homes and more. Contrarily to the onsite systems, piping systems are needed for the cluster systems, yet they are comparatively shorter than those used for the conventional centralized systems. Cluster systems are favorable in areas that are more densely populated or that have poor soil conditions and adverse topography. Generally, a cluster system may be considered as a centralized system if compared to the onsite system. However, a central wastewater treatment plant is more centralized than a cluster system. [4]

III. MUNICIPAL WASTEWATER GENERATION AND TREATMENT CAPACITY

There are 498 Class-I Cities (including Metropolitan cities) having population more than 1 Lacs per 2001 census. Sewage generated in these cities is estimated as 35558.12 MLD. Total sewage treatment Capacity of class-I cities is 11553.68 MLD, which is 32% of the sewage generation. There are 225 class-II towns in which sewage generation is 2696.70 MLD and Total sewage treatment capacity in Class-II towns is 233.7 MLD which is 8% of the total sewage generation. In Metropolitan Cities 15,644 Million Liters per Day (MLD) sewage is generated & sewage treatment capacity exists for 8040 MLD i.e. 51% treatment capacity.

Source: Status of sewage treatment in India (CUPS/61/2005-06) - Central Pollution Control Board

IV. CENTRALIZED VS. DECENTRALIZED WASTEWATER TREATMENT

As mentioned earlier, conventional or centralized wastewater treatment systems involve advanced collection and treatment processes that collect, treat and discharge large quantities of wastewater. Decentralized or cluster wastewater

treatment systems are designed to operate at small scale. They not only reduce the effects on the environment and public health but also increase the ultimate reuse of wastewater depending on the community type, technical options and local settings. When used effectively, decentralized systems promote the return of treated wastewater within the watershed of origin. Moreover, decentralized systems can be installed on as needed basis, therefore evading the costly implementation of centralized treatment systems. Unlike centralized wastewater treatment systems, decentralized systems are particularly more preferable for communities with improper zoning, such as scattered low-density populated rural areas. However, to collect and treat the wastewater, centralized wastewater treatment requires pumps and piping materials and energy, therefore increasing the cost of the system. Moreover, decentralized systems allow for flexibility in management and a series of processes can be combined to meet treatment goals and address environmental and public health protection requirements. (4).

V. MOST COMMON DECENTRALIZED TREATMENT AND DISPOSAL METHODS

DEWATS is based on four treatment systems:

- Sedimentation and primary treatment in sedimentation ponds, septic tanks or Imhoff tanks
- Secondary anaerobic treatment in fixed bed filters or baffled septic tanks (baffled reactors)
- Secondary and tertiary aerobic / anaerobic treatment in constructed wetlands (subsurface flow filters)
- Secondary and tertiary aerobic / anaerobic treatment in ponds.

The above four systems are combined in accordance with the wastewater influent and the required effluent quality. [6]

TABLE I. PROS AND CONS OF DEWATS

Type	Kind of treatment	Used for type of wastewater	Advantages	Disadvantages
Septic tank	sedimentation, sludge stabilisation	wastewater of settleable solids, especially domestic	simple, durable, little space because of being underground	low treatment efficiency, effluent not odourless
Imhoff Tank	sedimentation, sludge stabilisation	wastewater of settleable solids, especially domestic	durable, little space because of being underground, odourless effluent	less simple than septic tank, needs very regular desludging
Anaerobic Filter	anaerobic degradation of suspended and dissolved solids	pre-settled domestic and industrial wastewater of narrow COD/BOD ratio	simple and fairly durable if well-constructed and wastewater has been properly pre-treated, high treatment efficiency, little permanent space required because of being underground	costly in construction because of special filter material, blockage of filter possible, effluent smells slightly despite high treatment efficiency
Baffled Septic tank	anaerobic degradation of suspended and dissolved solids	pre-settled domestic and industrial wastewater of narrow COD/BOD ratio, suitable for strong industrial wastewater	simple and durable, high treatment efficiency, little permanent space required because of being underground, hardly any blockage, relatively cheap compared to anaerobic filter	requires larger space for construction, less efficient with weak wastewater, longer start-up phase than anaerobic filter
Horizontal Gravel Filter	Aerobic-facultative-anaerobic degradation of dissolved and fine suspended solids, pathogen removal	suitable for domestic and weak industrial wastewater where settleable solids and most suspended solids already removed by pre-treatment	high treatment efficiency when properly constructed, pleasant landscaping possible, no wastewater above ground, can be cheap in construction if filter material is available at site, no nuisance of odour	high permanent space requirement, costly if right quality of gravel is not available, great knowledge and care required during construction, intensive maintenance and supervision during first 1 - 2 years
Anaerobic Pond	sedimentation, anaerobic degradation and sludge stabilisation	strong and medium industrial wastewater	simple in construction, flexible in respect to degree of treatment, little maintenance	wastewater pond occupies open land, there is always some odour, can even be stinky, mosquitoes are difficult to control

Aerobic Pond	aerobic degradation, pathogen removal	weak, mostly pre-treated wastewater from domestic and industrial sources	simple in construction, reliable in performance if proper dimensioned, high pathogen removal rate, can be used to create an almost natural environment, fish farming possible when large in size and low loaded	large permanent space requirement, mosquitoes and odour can become a nuisance if undersized, algae can raise effluent BOD

[a.] Sasse, L. Status Report on Decentralized Low Maintenance Wastewater Treatment Systems (LOMWATS) by BORDA.

CONCLUSION

The conventional approach to wastewater has been to collect and bring it to a central point for treatment and disposal. Such systems have had limited effect, decentralization offers a strong alternative because it makes wastewater management more people-centered by emphasizing the role of households, communities, industries and decentralized municipal structures in wastewater management. In wastewater management challenge is to ensure that control measures and technologies provide protection to the environment, at lower cost and with economic and social benefits. Wastewater management is not yet a major concern for many stakeholders. Health risks posed by irrigation with untreated water are underestimated and information about technological and institutional options is inadequate. The appropriate selection of technological configuration, combined with further technological development, is essential to minimize potential malfunction of future systems. DEWATS offers Low primary investment with low maintenance cost and sustainability with flow up to 1000m3/day .providing DEWATS improves Institutional strengthening and administrative reforms through reduced government involvement and bureaucratic control coupled with user participation results proper and sustainable management of wastewater.

REFERENCES

[1] C. Heymans (2004). Driving policy change for decentralized wastewater management 30th WEDC International Conference, Vientiane, Lao PDR.

[2] Gutterer, B., (2009) Decentralised WastewaterTreatment Systems (DEWATS) and Sanitation in Developing Countries: A Practical Guide,Loughborough, UK: Water, Engineering and Development Centre (WEDC).

[3] Hoover, M. (1999). http://www.ces.ncsu.edu.

[4] May A. Massoud (2009) Decentralized approaches to wastewater treatment and management:Applicability in developing countries Journal of Environmental Management 90, 652–659.

[5] Paraskevas, P.A.(2002).Wastewater management in coastal urban areas: the case of Greece. Water Science and Technology 46 (8), 177–186.

[6] Sasse, L. and Otterpohl, R.(1996), "Status Report on Decentralized Low Maintenance Wastewater Treatment Systems (LOMWATS)", produced by BORDA in cooperation with AFPRO, CEEIC, GERES, HRIEE and SIITRAT. Commission of the European Union – Brussels and State Office for Development Co-operation- Bremen, Bremen.

[7] Status of sewage treatment in India (CUPS/61/2005-06)- Central Pollution Control Board.