सं०: 11011/11/2012-एनबीए

भारत सरकार

पेयजल एवं स्वच्छता मंत्रालय

12वॉ तल, पर्यावरण भवन,

सीजीओ काम्प्लैक्स, लोधी रोड,

नई दिल्ली, 110003

8 मई, 2012

सेवा में,

सभी राज्यों के प्रधान सचिव/ग्रामीण स्वच्छता प्रभारी सचिव,

ग्रामीण विकास तथा पंचायत, पंजाब सरकार ने हाल ही में वर्तमान अप्रयुक्त तालाबों के पुनरुद्धार/ नवीनीकरण के लिए लुधियाना और मुक्तसर जिलों में कुछ गांवों में जल स्थिरीकरण तालाब(डब्ल्यूएसपी) तकनीक को लागू करके अपशिष्ट जल शुद्धिकरण प्रणाली को कार्यान्वित किया है। राज्य सरकार ने यह इच्छा व्यक्त की थी कि लुधियाना जिले में पहले से कार्यान्वित ऐसे दो जल स्थिरीकरण तालाबों का तकनीकी-आर्थिक मूल्यांकन किया जाए।

इस मंत्रालय से विशेषज्ञों के समूह ने स्थलों का दौरा किया तथा अपनी रिपोर्ट प्रस्तुत की(प्रति संलग्न है)।

अपने राज्य में ठोस तथा तरल अपशिष्ट पदार्थ प्रबंधन के बेहतर कार्यान्वयन के लिए तकनीकों को पुन: उपयोग करने के लिए संभावनाओं की तलाश करने हेतु रिपोर्ट को देखें।

इस विषय पर फीडबैक, यदि कोई हो तो, भेजें।

विजय मित्तल

निदेशक, (सीआरएसपी)

प्रति:

1. टीएससी समन्वयक सभी राज्य।
2. निदेशक (एनआईसी) वैबसाइट पर डालने हेतु।

Government of India
Ministry of Drinking Water and Sanitation

Study of Waste Water Treatment Technologies adopted in Ludhiana and Muktasar Districts of Punjab by the State Government

Study of Waste Water Treatment Technologies adopted in Ludhiana and Muktasar Districts of Punjab by the State Government

Reference:

Hon'ble Chief Minister of Punjab, Shri Parkash Singh Badal has brought to the notice of Hon'ble Minister of Rural development and Drinking Water and Sanitation, Government of India, vide his D.O. letter dated 22nd March, 2012, the problems related to the disposal of waste water and need of rehabilitation of village ponds in Punjab. He has informed that some pilot projects based on the technology of UNICEF and GoI have been implemented by the Govt. of Punjab in Ludhiana and Muktasar districts and the State is keen to replicate this technology in the entire State. It was decided in his meeting with Hon'ble Minister, RD and DWS, Govt. of India, on 20th March, 2012, that a Technical Team will be sent by the Govt. of India to study the problem and conduct an evaluation of the techno-economic feasibility of the technology adopted by the State of Punjab. The Financial Commissioner, Rural Development & Panchayat, Punjab also requested the MoDWS vide his letter no. 1633 dated 27th March, 2012, to send a Central Team.

Constitution of Central Team:

Responding to the above requests, the Ministry of Drinking Water and Sanitation, Govt. of India, vide O.M. no. W-11011/12/2012-CRSP dated 29th March, 2012, constituted a Team for this study. Members of the committee, Shri Sudhir Saxena, Senior Consultant & Team Leader (Water), National Resource Centre, MoDWS and Dr. P.K. Jha, Consultant (Sanitation and Waste Management), National Resource Centre, MoDWS, visited the sites in Muktasar and Ludhiana districts, on 4th and 5th of April along with Chief Engineer, Mr.A.K.Soni, Superintending Engineer, Executive Engineer and other officers of the Departments of Water Supply & Sanitation and Panchayat, where such works under the pilot project have been done. The team members also met Hon'ble Chief Minister of Punjab on 5th April, during his visit to the rural areas of Malout in district Muktasar, who explained the problems of waste water disposal and pollutants flowing into the streets of the villages.

Brief details of the villages visited:

Village Mohlan, Mandal Malout, District Muktsar:

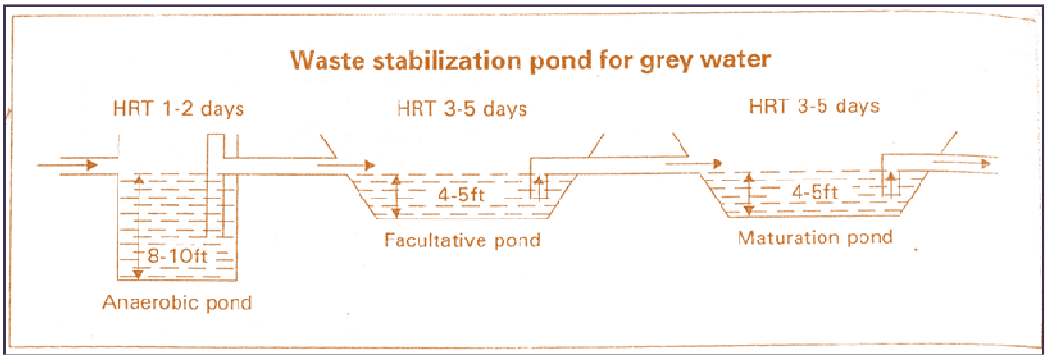
A pond exists in this village, where all the waste water of the village gets accumulated. At the time of visit, there was no water in this pond and only a small part of the pond was getting some waste water, through a drain. The officials informed that during rainy season, this pond gets flooded and the back water enters the village lanes and consequently some nearby low lying areas are required to be vacated. No arrangement of waste water disposal has so far been made in this village.

The team also inquired about the drinking water arrangements in the village and was taken to a water treatment plant, based on the canal water. This plant gets water from the nearby canal and after treatment; water is supplied to the village. The officials present, informed that this scheme was handed over to the Panchayat and it was their responsibility to run and maintain this scheme. The scheme was defunct since last about two months as raw water was not being received from the canal due to some ongoing repair work of the canal. On inquiry, it was told that the Panchayat was unable to collect any revenue from the village users for this scheme and whenever some minor repairs or maintenance expenses were necessary, such amounts were being arranged by some functionaries of the Panchayat in their personal capacity.

A Reverse Osmosis Plant has also been installed in this village, as has been done in most of the villages, which supplies water to the villagers in cans at a price of Rs. 60/- per month for supplying 20 litres of drinking water per day. This comes to Re. 0.10 per litre of treated water which appears to be quite reasonable. The approximate population of the village is about 3000 persons with about 450 households. Out of these, about 150 families are taking water from this plant presently. This figure increases to about 200 in summer. Cards have been made for the families taking water from R.O. plant and daily marking is done by the attendant at the time of issue of water cans to the card holders. This RO plant is based on a tube well of 150 mm dia and about 80 mts depth, having high TDS. For the present requirement, only about one hour pumping is sufficient. The flow of treated water is about 2000 lph and the reject flow is about 1800 lph.

Details of the WSPs visited:

The team visited the WSPs constructed in some of the villages to treat waste water (grey water) along with State officials. Local MLA was also present during the visit at some places. Technology for the treatment of waste water at all the places is same; a typical schematic diagram of the plant units is as below:



1. **Village Birk, Block Sidhwan Bet, District Ludhiana:**

Village Birk is located on Ludhiana – Firozpur road, about 27 KMs from Ludhiana. The present population of the village is 2760 with 425 households.

Water Supply Scheme of this village was commissioned in March, 2012 under ARWSP, SWAP Project, at the rate of 70 lts per capita per day supply and is running presently. The O&M of the scheme is being done by the Drinking Water Supply Dept., Punjab. The Water Supply Scheme is based on a Tube Well. Water is distributed through an Overhead Tank, about 300 household connections have been given and almost full recovery of water charges is being done. Monthly domestic water rate is Rs. 85/- per connection.

A WSP has been constructed in the village to treat waste water. Earlier all waste water of the village was coming into a shallow and redundant pond causing nuisance for the village and also chocking of the village drains. The Village Gram Panchayat Water Supply & Sanitation Committee, along with village community, expressed the desire for a systematic WSP to overcome the problem. A WSP was constructed covering an area of 3.5 acres. The work was sanctioned by the District Water Supply & Sanitation Mission. The total expenditure incurred on the work is about Rs. 10.5 lakhs, out of which beneficiaries' contribution is Rs 1.5 lakhs. Rest of the amount has been provided from the Sustainability Head; accordingly, per capita cost of the system comes to about Rs 380, excluding cost of sewerage system.

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The waste stabilization plant comprises of four ponds. The first pond i.e. anaerobic pond receives raw grey water from the existing drainage system of the village, the second pond acts as a facultative pond and the remaining two ponds act as maturation ponds. All the ponds are connected in series and waste water flows by gravity. Presently, waste water from the first pond, which is

anaerobic pond, flows to the second pond, which is a facultative pond and the maturation ponds are empty as the effluent from the facultative pond is yet to reach the maturation ponds. This is due to over size of the ponds in comparison to daily inflow of waste water as well as leaching of waste water in soil. P.V.C. and R.C.C. pipes have been used for inlet, outlet and overflow arrangements. Slopes of the earthen embankments have been kept as 1V to 1.5H with a top width of about 2.5 metres.

The villagers, the committee members and the M.L.A., present at the spot, informed that after renovation of this pond, there is cleanliness in the area, there is no foul smell and this has improved the sanitation conditions in the village. No foul smell was felt during the visit of the team.

2. Village Gure, Block Jagraon, District Ludhiana:

Population of village Gure is about 3600 with about 650 households. The water supply of the village is based on a tube well. This water supply scheme was commissioned in the year 1997 under ARWSP and is being run and maintained by the GPWSC. Only about 50 house connections have been given and the water rate is Rs. 75/- per connection, per month. In addition, most of the households also have their private tube wells.

The waste water, till now, was getting accumulated in a low lying land and was creating foul conditions in the village.

The villagers decided to convert this land in to a waste stabilization pond system. The renovation work at this land was under progress at the time of field visit and JCB machines were working for making the pond compartments and the embankments. The accumulated waste water was first diverted and channelized into a corner of this land by doing earth work and making a coffer dam. Remaining land area was then taken up for excavation, earth work and making embankments to make three ponds. These ponds will work as anaerobic, facultative and maturation ponds and this system, comprising of all these ponds will work as waste stabilization treatment system. As the work is still under construction, details of sizes and cost etc were not available, the approximate cost was said to be about Rs. 10 lakhs.

3. Village Dewatwal, Block Ludhiana, District Ludhiana:

Village Dewatwal is located on Ludhiana – Ferozepur road, about 15 Kms from Ludhiana. The population of the village is about 2500 persons and about 450 households.

The water supply scheme of this village has been commissioned in December 2010 and is based on a deep tube well of about 150 mts depth, yielding about 1.25 lakh litres water per hour. The scheme has been implemented with World Bank assistance and the design rate of supply is 70 lpcd. Public contribution for implementation of the scheme has been collected at the rate of Rs. 800 per general household and Rs. 400 from SC households. The water is distributed twice daily through an over head tank of one lakh litres capacity. O&M of the scheme is being done by the Panchayat (GPWSC) and about 318 private house connections have been given. The water charges are Rs. 70 per connection per month and the Panchayat has some net balance amount from the scheme.

Earlier, **w**aste water of the village was coming in the existing shallow and redundant village pond of 3.5 acres area and was causing foul conditions. During rainy season, the over flow from this pond used to enter into the village streets and the drainage system of the village was getting dysfunctional due to this flooding.

The Gram Panchayat Water Supply & Sanitation Committee and the village community expressed their desire to renovate this pond and came forward to contribute their share for this work. Four ponds in series were constructed at the site. The scheme of renovation of the pond was approved by the District Water and Sanitation Mission, under TSC programme.

The existing pond was emptied first in to a nearby vacant land and was then desilted. Earth work was done to construct four ponds**,** connected in series, by excavation and making embankments. The village out fall drain was diverted in to the first pond which is designed to act as anaerobic pond. The effluent from this first pond flows to the second pond i.e., facultative pond and from this pond to two nos. of maturation ponds, connected in series. The settleable solids settle in the first pond and the effluent reaches the second, facultative pond. It was informed that the anaerobic pond was designed for 3 mts water depth and 5 days detention time, the facultative pond for 1.5 mts water depth with 5 days HRT and the two maturation tanks were also designed for 1.5 mts water depth and 5 days HRT, these depths are as per standards. As the height of the embankments was more, the pipes were fixed at lower levels so as to maintain these water depths. Both the maturation ponds were empty at present as waste water from facultative pond was not reaching the maturation ponds. This is again due to these ponds being over sized in comparison to the inflow of waste water and also loss of water due to leaching and evaporation.

Area of the WSP is 3.5 acres and the cost is Rs. 10.25 lakhs, out of which an amount of Rs. 5 lakhs was received from TSC, Rs. 4 lakhs from Sustainability head and the remaining Rs. 1.25 lakhs, as community contribution. Per capita cost of the system accordingly comes to Rs 410, excluding the cost of sewerage system.

After construction and renovation, the area is free from foul smell. A park has also been developed at this site.

The Waste Stabilization Pond Technology:

Traditionally, Ponds have been in use for centuries to store and treat animal and household, domestic waste waters. However, within last about five decades, have the specific design criteria been developed in terms of volumetric requirements, organic loading rates of the waste water and detention periods.

Untreated waste water causes major damage to the environment and to the human health therefore waste water should be treated in order to reduce the transmission of excreta related diseases and reduce water pollution and consequent damage to aquatic biota. Stagnant waste water will also pollute the ground water in long run, therefore the waste water must be treated and suitably disposed off.

Waste Stabilization Ponds are very simple structures to construct, earth work is the main activity involving excavation of the soil within the pond areas and refilling the same excavated soils for

making proper beds and the embankments. Other civil works are minimal with little preliminary treatment requirements, fixing of the inlet, out let and the over flow pipes, protection of the embankments, pond lining, if necessary, depending on the soil type. WSPs are very simple in construction and also in Operation and Maintenance. Land is the main costly requirement but generally available land is only used or the existing ponds are converted in to WSPs.

The Waste Stabilization Ponds do not require any electrical energy, making them cost effective from the O&M point of view also. WSPs are extremely efficient and they can easily achieve the BOD and the suspended solids removals up to more than 90% and so also the removal of the Ammonia to equal extent. These are particularly efficient in removing excreted pathogens in contrast to all other treatment processes requiring a tertiary treatment process such as Chlorination to achieve destruction of the bacteria.

Waste Stabilization Ponds are very robust due to their long retention periods and more resilient to both, organic and hydraulic shock loads than other waste water treatment processes. They can also cope with high levels of heavy metals.

Decentralized waste water treatment plants are better as they minimise the cost of sewerage systems and the expenditure on pumping of the sewage to long distances. Due to warm climate and sufficient availability of land in the rural areas, such decentralized plants are best suited and are sustainable.

Treatment process in WSPs:

Waste Stabilization Ponds are large shallow basins enclosed by earthen embankments in which raw waste water is treated entirely by the natural processes involving both algae and bacteria. As the rate of natural oxidation is slower, longer retention periods are required.

Stages of treatment:

First stage of waste water treatment is the removal of large floating particles and heavy mineral particles such as sand and grit which can be done by simple screening and grit removal before the raw waste water enters the other units of the WSP.

Measurement of the incoming waste water is important which can be done by a Venturi or Parshall flume, before it enters the treatment units. It is essential for determining diurnal flow variations and for evaluating the performance of the treatment system.

The system typically comprises of three treatment units, the anaerobic pond, facultative pond and the maturation ponds. Liquid depths in these units are 2 to 5 metres in the anaerobic ponds, 1 to 2 mts in the facultative ponds and 1 to 1.5 mts in the maturation ponds. The depth of the anaerobic and facultative ponds should be more than 1 metre so as to avoid growing of the vegetation from the pond base, resulting in to hazards of mosquito and snail breeding.

Anaerobic and facultative ponds are designed for BOD removal and the maturation ponds are designed for faecal bacteria removal. Some removal of faecal bacteria does take place in the

anaerobic and facultative ponds and some BOD removal occurs in the maturation ponds also which also remove some of the nutrients.

Facultative and maturation ponds are photosynthetic ponds i.e. the oxygen needed by the pond bacteria to oxidize the waste water BOD is mainly supplied by the micro algae which grow naturally in these ponds and the Carbon dioxide needed by the algae is mainly provided by the pond bacteria as an end product of their metabolism.

Anaerobic Ponds:

These are 2 to 5 metres deep tanks which receive such a high organic loading, generally more than 100 gms BOD/cum. Day, equivalent to 3000Kg./ha day, containing no dissolved Oxygen and no algae. Primary function of these units is BOD removal. A properly designed and not significantly under loaded anaerobic pond will remove 60% or more BOD at 20°C. Retention times are short, one day time is sufficient for a BOD up to 300 mg/l at 20°C . BOD is removed by sedimentation of the settleable solids and their anaerobic digestion in the resulting sludge layer. Heavy metals are also precipitated and many toxicants are also degraded to non toxic forms. Floating materials such as scum and oils etc, which block out the Sun light needed for algal photosynthesis in the subsequent facultative ponds, are also retained in these anaerobic ponds. Regular desludging, about once in one to three years, is required to be done. Scum accumulates on the surface but is not removed as it keeps the pond in anaerobic state, unless fly breeding reaches nuisance stage.

Facultative Ponds:

These units of the waste water treatment plants are designed for BOD removal on the basis of low surface BOD loading in the range of 100-400kg/ha day to permit the development of a healthy algal growth, as the Oxygen for BOD removal by pond bacteria is mostly produced by algal photosynthesis. Liquid depths are usually in the range of 1 – 1.8 mts, 1.5 mts being most common. Depth of less than one metre does not prevent the emergence of vegetation and must be avoided otherwise the pond becomes an ideal breeding ground for mosquitoes. Similarly with depth of more than 1.8 mts, the pond becomes anaerobic, which is also undesirable.

Siting of the WSP in an open area is desirable so as to take advantage of Sun and wind which assist in the efficient operation of the facultative pond and thus improve the quality of the pond effluent.

Maturation Ponds:

Main function of the maturation pond is to reduce the number of excreted pathogens, mainly the faecal bacteria and viruses present in the effluent received from the facultative ponds. These pond units are typically aerobic throughout their depth. Generally the depth of these maturation ponds is about one metre, shallower ponds are more efficient due to greater light penetration, but unlined ponds with depths less than one metre are likely to contain emergent macrophytes which are rooted plants growing from the pond base. These provide a shaded habitat for mosquito breeding and so should be avoided, unless such ponds with less than one metre depths are lined.

The principal mechanism for faecal bacteria removal in these ponds and also in the facultative ponds, are temperature, high pH values and high light intensity. Faecal bacteria and other

pathogens die off due to higher temperatures, high pH or radiation of the Sun, leading to solar disinfection.

Observations and Recommendations:

- As mentioned in the fore going paragraphs, Waste Stabilisation Pond technology is the simplest and most suitable technology to treat waste water in rural areas. It is a proven technology being used in different places and countries. The technology adopted for different sites visited, is as per the norms. However, sizes of the ponds are larger, looking to the population of the villages and the waste water discharge.
- In case of places with high water table, there are chances of ground water pollution through WSP or any other technology using ponds. It has been informed by the local officers that ground water contamination was not likely as the ground water levels in the area were 18 to 20 metres and drinking water Tube Wells were generally drilled up to 125 mts. However, to minimise loss of water through leaching, and avoid any possible chance of ground water pollution, it is suggested that suitable lining material, such as plastic sheets be used in the anaerobic ponds, topped with soil cover. A protocol for ground water quality monitoring should also be developed to regularly monitor the ground water quality near such WSPs. Such treated effluent has plant nutritional value and could be used for agricultural purposes.
- Incoming waste water and outgoing effluent from each unit of the WSP should also be measured through some simple measuring devices to monitor the performance of these treatment ponds. Representative samples of the effluents from each unit may also be taken on a regular basis and analysed for those parameters for which effluent discharge or reuse requirements exist.
- It is also suggested to use boulders at the inner embankment of the ponds, up to the level of waste water, to check any erosion of soil. This would also help in the maintenance of the embankments.
- Per capita cost of these treatment systems is coming to about Rs 400, excluding the cost of sewerage system as the existing drainage system through open drains and partly sewerage is being utilized. This per capita cost is quite reasonable due the fact that low land areas or existing village ponds have been used to make these WSPs.
- Since there will be no discharge of effluent into any river and the effluent will be used for agriculture in nearby areas, the question of meeting standard discharge norms of the Central or State Pollution Control Boards does not arise. However, officials were requested to send the analysis reports of treated waste water. As already mentioned, presently no effluent is coming out of the facultative ponds and it may take quite some time for it to reach the final outlet of the system.
- A simple maintenance protocol and check list for maintenance of such WSPs should be prepared and made available to the PRIs and the departmental staff. Points related to removal of screenings and grit, cutting and removal of the grass on the embankments, removal of floating scum and floating duckweed from the surface of the facultative and maturation ponds to maximise photosynthesis and surface aeration, , recording of the inflow and out flow measurements, sampling and testing of the samples from various units, desludging details of the anaerobic pond etc should be included. The maintenance functionaries of the PRIs should also be trained on these aspects.

- Efforts for convergence with MNREGS to reduce the cost burden should be made, though difficulties such as removal of sludge from the existing village ponds manually are there, earth work in dry areas of the pond may be taken up.

- In general, renovation of the existing unused village ponds, which had become sludge ponds and were creating foul conditions, into Waste Stabilisation Ponds with community participation, has been useful in terms of waste water treatment and environmental up gradation. Care should be taken for the above mentioned points.

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