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REACHING THE UNREACHED: CHALLENGES FOR THE 21ST CENTURY

Pollution travel from leach pits

Chandan Sengupta, India

HUMAN EXCRETA MAY contain a vast number of pathogens, eggs of helminths (worms), protozoa, bacteria an viruses. These, when ingested, have the potential to cause diseases in people. This is why, to avoid excreta-related diseases, safe excreta disposal is so important. The status of providing sanitation facilities, particularly safe disposal of human excreta in the developing countries, is very poor. For example, in the rural areas of India, access to toilets is only to the extent of about 10 per cent (as per 1991 census).

Waterborne sewerage is the ideal system of disposal of excreta and sullage. But its cost is so high, that it is just not within the reach of the poor communities of the developing countries. Accordingly, in developing countries, an appropriate on-site sanitation system has been considered to be an alternative.

Moreover, on-site sanitation is much simpler as it does not require a large volume of water for its operation. Latrines attached with septic tanks,VIP latrines,pour-flush latrines, compost toilet, aqua-privy, etc., are some examples of on-site sanitation facilities of excreta disposal.

In the Indian sub-continent and in the Far-East, pour flush toilets attached with two leach pits are considered to be the most appropriate option for on-site sanitation. To achieve the global goal of providing sanitation to all by 2000 A.D., the sanitation programme is now being intensified in all countries resulting in innumerable numbers of such leach pits.

This type of on-site sanitation, of course, has the potential danger of polluting ground water — which many countries are now considering as the only source to provide drinking water to the vast unserved population. Though some studies have been carried out, sufficient information is not yet available on the relationship between ground water quality and on-site sanitation.

Leachate movement in natural soil

Principles

Natural soil is an effective system for the disposal of human waste. During the passage of leachate through soil media, the micro-organisms are arrested and the leachate is upgraded due to breakdown of many chemical compounds. In the process, purification of waste takes place. The efficiency of the soil profile for upgradation of leachate is dependent on the characteristics of soil state. Thus, the performance of most on-site sanitation systems depends on the characteristics of soil, e.g. type of soil, soil mixture, composition or texture, grain size, etc.

Leachate carries mostly pathogenic organisms, organic compound, etc. Travel of pollution, however, is also dependent on various other hydro-geological factors, namely, ground water table, saturated or unsaturated condition of soil, hydraulic gradient, etc.

Previous study on pollution travel

In the past, a good number of people worked on pollution travel in the ground. But most of the works have been carried out in the United States and are related to the disposal of septic-tank effluent. Although health and sanitation problems in the developing countries are now most acute, little work has been done in these countres.

Purpose and scope of the study

A project titled "Integrated and Ecological Balanced Approach for Water Supply and Sanitation" was undertaken by the All India Institute of Hygiene and Public Health (AII&PH), Calcutta in collaboration with UNICEF, in Hooghly and Medinipur districts of West Bengal in the year 1993.

A study on pollution travel from leach pits was undertaken in these districts along with other activities in different geo-hydrological conditions. Such conditions include texture and characteristics of soil and its composition, ground water condition (saturated / partly saturated / unsaturated) etc. The previous studies basically highlighted findings on pollution travel, mostly in general conditions of the soil. But variation in soil condition vis-a-vis rate of permeability plays an important role. Accordingly, within the scope of the present study, microlevel variations in soil characteristics have been taken into consideration. The study is an ongoing one and is being spread to cover other geo-hydrogeological conditions.

Location and soil condition of study

Studies from pits of on-site sanitation have been carried out in different places of Hooghly and Medinipur district. Soil analysis have even carried out by collecting undisturbed soil samples before carrying out study of pollution travel. Location-wise soil conditions are mentioned in Table I in the Annexure.

Methodology

- Leach pits linked with pour flush toilets were undertaken for study.

- Observation wells were installed at intervals of one meter from each pit in straight lines in different directions keeping an initial distance of 2 metres from the pit. The observation wells were PVC pipes of either 3 meters or 5 meters length. At the top, blank pipes of 0.5 metres to 1.0 meter and at the bottom slotted pipes were provided.
- Highly concentrated (25,000 mg / 1) salt solution was charged in the leach pits and concentrations of chloride content in the samples of the observation wells were monitored. In some case, dye was charged in the pits to monitor the travel.
- Total coliform and faecal coliform (MPN) count were observed.

Table 1. Study on pollution travel from under ground leach pit

- Steeper hydraulic gradient was achieved by way of pumping.

Findings

Results for 10 sites in different geo-hydrological conditions have been shown in Table I. The findings can be classified as under:

- Pollution travel depends on the ground water table (whether the soil is saturated, partially saturated or unsaturated), hydraulic gradient of ground water, permeability, effective grain sizes, type of soil etc.
- Pollution travel has been found to be comparatively higher in the case of saturated soil conditions.
- In sandy formation of soil, travel is more than clayey silt or salty clay type of soil. In unsaturated sandy soil, travel was found to be 7.14 meters in 10 days even at a flatter hydraulic gradient of 0.00175.
- In case of unsaturated clayey salt soil of effective grain size 0.002 mm (sand 9.00 per cent, silt 72.00 per cent clay 9.00 per cent, permeability 2.728×10^{-5} m / sec), 10 days pollution travel was found to be 2.286 meters. It means travel is less in case of soil either containing more clay or more silt.
- In case of steeper hydraulic gradient, travel is much more. Even in sandy silt conditions (sand 42.33 per cent, silt 48.00 per cent, clay 9.67 per cent) of effective grain size 0.004 mm and permeability 2.58×10^{-4} m / sec, the pollution travel was noticed to be more than 10 metres in 2 days, then hydraulic gradient was artificially converted to the extent of 0.3 by way of pumping.

Conclusion

- In case of sandy formation, travel of pollution is found to be much more. Either adequate distance in between the water wells and leach pits is to be maintained or artificial envelope surrounding the leach pit is to be provided in such cases.
- In areas where the hydraulic gradient is steep, the travel of pollution is alarmingly high irrespective of the soil condition. Care should be taken in areas where ground water from shallow layers is exploited, particularly for agricultural use.
- In case of soil having more clay or silt content, the 10 days travel was found to be very much less. In such conditions, safe distance can be reduced to 5 meters in place of the existing norm of 10-15 metres.
- No general guidelines can be issued to the implementors of the sanitation programme regarding the safe distance in between leach pits and water wells. Area specific guidelines can however, be issued after a study of the soil conditions of that area.
- Promotion of leach pits for latrines should be done with great care in areas where dug wells or any other surface water body like a pond etc., is used either for drinking or other domestic purposes.

References

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