

Sanitation in Human Habitation



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Abstract

Sanitation problems are conventionally understood to arise due to some 'nasty' creatures created by nature, as if only to harass man. Man, being the supreme creation of nature, has developed ingenious ways to trap these creatures and destroy them or resort to mass poisoning of the ecosystem using the chemical weapons. In this warfare, the target organisms die faster (and also produce resistant organisms due to their fast breeding potential), big creatures (such as man), die slow, by developing emerging diseases. It has now become necessary to understand the root-cause of these sanitation challenges and develop eco-friendly remedies that correct the root-cause.

Similarly, conventional focus on handling of garbage and sewage has been transport and disposal outside the community. This is a typical NIMBY approach, NIMBY means - Not In My BackYard. It is necessary to understand garbage and sewage as 'wasted organics', rather than 'organic wastes', wasting any resource only causes pollution (alarm bells of waste-age).

Sewage tends to flow by gravity and reach our water bodies such as lakes and rivers, causing their deterioration. Well-sewered area needs sewage-pumping station and sewage treatment plant, history has shown that these are difficult to operate and maintain and need scarce electricity. These are planned and installed because there is an economy of scale, that is big units are cheaper to install and operate. But, we can use ecotechnologies to develop decentralized recycling units; these are more relevant in countries in warm region where ecotechnologies work more effectively. They are also more relevant in unsewered areas and shantytowns.

INTRODUCTION

Bhawalkar Ecological Research Institute (BERI) has been working in the area of waste recycling and ecosanitation over the past 30 years. We have all realized the limitations



Bio-spray - 'Sanitation of Garbage using BIOSANITIZED Water Spray'

of the conventional approaches such as NIMBY or 'dilution and disposal', also the current emerging approach of 'concentration and disposal' has obvious limitations and hazards. It is necessary to handle wastes generated in human society, using eco-logical approach.

UNDERSTANDING SANITATION

Since chemical technology developed much earlier before we could understand the ecology of odour-causing bacteria, pathogens and pests, the obvious remedy for these sanitation challenges was to use toxic chemicals. But now that we have understood hazards of such chemical poisoning, it is necessary to understand the eco-logic of nature's warning bells; these are: odour, pathogens and pests. Bhawalkar Ecological research Institute (BERI) has studied these mechanisms over the past 30 years and have come out with the following meaning of sanitation:

- Waste is a neglected resource.
- Nitrates are resource for plant growth;

hence nature does not approve waste of nitrates.

- All sanitation challenges arise from waste of nitrates.
- What we understand as sanitation challenges, are actually the warning bells, these are: odour, pathogens and pests.
- Nitrates come from our drinking water itself, more come from food grown using chemical fertilizers.
- True sanitation (ecosanitation) aims at correcting the root-cause.

Why are the farmers using chemical fertilizers that need to be purchased by them (thus reducing their profit)? Also why does the government encourage their production and promotion when they use scarce imported non-renewable raw materials that cost our economy? The answer is: both the farmers and the government have lost faith in ecology. Ecology works better in warm region; we have been copying the western

developmental model that uses less ecological wisdom. They cannot fully harness ecology in the cold region they are in.

Why do nitrates come from our drinking water? Traditionally we used groundwater that was free of nitrates. Groundwater was the best source for drinking water because it was the result of rainwater (has nitrates) getting filtered through healthy soil with active plant root-zone. Nitrates get utilised by the actively growing plants. But when chemical fertilizers appeared on the scene, they started polluting the groundwater and we started preferring the rainwater stored in the dams. Once groundwater is spoiled with agrochemicals (chemical fertilizers and pesticides), it is very difficult to treat it. Most of our groundwater has been spoiled, in a similar manner that of technologically advanced countries. After all, they also used agrochemicals in far greater quantities and much before us.

But why did farmers adopt chemical agriculture and discontinue their age old

organic agriculture? The answer is more biomass started going away from the farms and waste recycling became difficult. Also, rainwater got polluted due to nitrogen oxides in air and the nitrate-rich rainwater refused to infiltrate readily into the soil, thus reducing the groundwater reserve and also increasing floods in the rainy season. The polluted rainwater also killed the soil ecology that can produce nitrates as per the genuine needs from the plants. Such soils became less productive and gave remarkable response to chemical fertilizers. But like alcohol, farmers had to use increasing doses of fertilizers because soil developed faster mechanisms of denitrification. This also explains why the farmers' profits went down with time and we see increasing number of farmers' suicides now.

How the rainwater got polluted with nitrates - Traditionally, we used biomass fuels that have C, H and O. These are eco-fuels. But fuels that are produced in unhealthy conditions may have only C and H; these produce higher amount of nitrogen oxides when they are used. Man has been using such fuels (coal, petrol, diesel, kerosene, LPG, CNG, methane, hydrogen, etc.) in the last 200 years and we see the nitrogen oxide (and Carbon dioxide) levels going up exponentially in air during the past 200 years, too. Rainwater dissolves these gases readily and hence we get polluted rainwater. Not only it fails to recharge the groundwater, it also creates runoffs and carries precious topsoil into our water bodies, thus reducing their active life.

Do we not remove nitrates in water treatment? No, we just try to remove the pathogens that come due to nitrates. We also add toxic chlorine, to avoid recontamination during water distribution. This is done because the root-cause (nitrates) and its correction method was not developed all these years.

How can we assess whether our tap water has nitrates? Any lab can do it for a fee; WHO allows up to 45 ppm nitrates in drinking water, but this is too high ecologically. True limit should be one that does not cause alarms of nitrates, such as odour, pathogens and pests. These can be noticed by all, without paying any fee.

Stored water starts smelling, even the stored mineral water may smell. This



'Cleaning of a Polluted Water Pond'

indicates high nitrates, the nitrate value is temperature specific, that is, high temperature causes faster alarm bells, this is why the scientists in the cold region decided to allow 45 ppm nitrates in our drinking water.

Stored water breeds malaria/dengue mosquitoes only due to nitrates. Clean groundwater that has no nitrates cannot breed any mosquitoes upon storage. The fact that modern municipal corporations have been spending huge sums educating the public that 'clean water breeds malaria/dengue mosquitoes' confirms that the water supplied by them has nitrates!

While these malaria/dengue mosquitoes need 'clean' water, what is preferred by ordinary mosquitoes (that only bite or sing a song)? Well, the answer may shock you. Open sewer or **gutter water may breed ordinary mosquitoes** if the nitrates are high, along with the organic food. With low nitrates, gutter water may breed frogs and still with lower nitrates may give us fish, sort of a reward for keeping the nitrates low. Also, it is interesting to note how nature starts warning and punishing us for increasingly higher levels of nitrates.

How can we assess ourselves whether the tap water is capable of growing the pathogens, before we fall sick?

One can find this out within 24 hours without any lab. Just store the water in a copper vessel. Inspect it after 24 hours by noting the inner surface that has been in contact with water. If it has developed a slimy layer and has stained the vessel, the water has high nitrates that may support the growth

of pathogens. Copper has a way to correct the nitrates (but this is not the best mechanism, ecologically). That's why our forefathers used to store water in copper/brass vessels and also the door fittings of toilets are made of copper so that they do not carry pathogens. But now, we have a cheaper and more effective way of nitrate management, using the BIOSANITIZER.

BIOSANITIZER ECOTECHNOLOGY

This technology was developed by Bhawalkar Ecological Research Institute (BERI), in collaboration with nature, through study of modern emerging branches of ecology and ecological engineering. BIOSANITIZER granules are the natural bio-catalyst that has a long working life, they are placed in contact with our drinking water, in a well, borewell or in a water storage tank. The tank needs no cleaning and one gets water that resists scaling, corrosion and growth of pathogens and pests.

CASE STUDIES

BIOSANITIZER has been used successfully in several field-scale projects to demonstrate its efficacy. Some examples are listed in this section.

Virus Control in Aquaculture: BIOSANITIZER was applied, in 1997, in a commercial prawn farm where the production was reduced due to viral attack. It is well understood in the aquaculture industry that management of nitrates (and other nitrogen species such as ammonia, nitrites, etc.) is a key to healthy prawn/fish growth. Increase



'On-line Sewage Treatment with BIOSANITIZER Ecotechnology'

in the nitrogen load reduces the dissolved oxygen (DO) level, particularly during the night when algal oxygen production stops. At low DO concentrations, prawns are under stress, which reduces their resistance to viruses. Virus is a wasteful mechanism of nature that uses nitrates but does not produce any resources. It is an alarm indicating that the nitrate level is high. The nitrate overload, and hence the viral problem was solved by use of BIOSANITIZER, at the rate of 1 gram per acre of pond (2-3 meters deep). Because of the oxygen production by the BIOSANITIZER, the food chain that converts prawn waste into prawn food also got triggered. Expenses on prawn feed thus got reduced. This resulted in higher food conversion ratio and higher profit for the prawn farmer. The need to change the polluted water from the pond was also reduced, because prawn waste was feeding the algal food chain that produced the prawn food. Thus, waste of one process was utilized to feed another useful process. In conventional waste treatment, both organics and nitrates are destroyed to clean the water, which amounts to spending more resources to destroy wasted resources.

Sewage Treatment: Taj Hotel at Madurai (in Southern India) had set up a conventional sewage treatment plant wherein a compressor was to be used to inject air into diffuser pipes submerged in the aeration tank. This plant was retrofitted with BIOSANITIZER, in 1997, and aeration system was turned off. BIOSANITIZER was able to produce tertiary treated sewage without any recurring charges, also without producing any sludge and greenhouse

gases. The aeration tank developed a floating scum that supported a floating garden. The project has been working satisfactorily for 7 years now, and has been monitored by the Tamil Nadu Pollution Control Board. The treated water is used for gardening. It has reduced inputs on fertilizers because the treated oxygen-rich water acts as a bio-stimulant to the plant life. It also helps reduce pest problems, thus achieving ecosanitation.

Lake Clean-up: Powai Lake of Mumbai and Pashan Lake of Pune were successfully treated with a one-time dose of BIOSANITIZER. Both the lakes were getting sewage streams into them, rainwater coming only for about 60 days of the year. Powai Lake water quality was monitored by the Indian Institute of Technology, Bombay, and that of Pashan Lake was monitored by the Pune Municipal Corporation (PMC). Water hyacinth and mosquito breeding were controlled in both the lakes. Instead, useful vegetation such as lotus plants and fodder grass have started growing. They are being regularly harvested as a resource. The bottom mud also became clean; it supported silky lawn grass (and not thorny/poisonous plants) when the lake bottom was exposed to sunlight in the summer. Lake mud also became soft and suitable for Ganesh idols. These observations indicate that after surface water gets cleaned, Nature starts cleaning the bottom of the water bodies. Silky grass can grow, without weeds, only on the clean soils. Earthworms also appear in such soils; they grind soil particles down to one micron, making the soil suitable for Ganesh idols.

Ecosanitation of Sewers: After the death of four municipal workers, in 1997, in the sewer system near a public toilet in Pune, BIOSANITIZER was used by the PMC. The death was due to the generation of toxic gases such as hydrogen sulfide, mercaptans, etc. due to high nitrate-loading from the public toilet. BIOSANITIZER solved the problem by locking the nitrates and producing oxygen in the process. BIOSANITIZER action was immediate, and one could note the reduction in the toxic gases and oxygen production within a few minutes.

It was observed that by adding the BIOSANITIZER catalyst granules at the higher level of the sewer system, one can start sewage treatment by using the sewers as bioreactors. The sewers were observed to remain relatively free of sewer corrosion, foul gases and scavenging creatures such as cockroaches, rats, redworms - were not readily observed.

Ecosanitation of Sewage Streams (Nallas): When a city has unplanned fast growth, sewage is seen to flow to the river or lake via natural streams which also carry storm water during rainy season. Rain is seasonal (for about 60 days) in most of India; during the rest of the year these streams carry sewage. Being deprived of oxygen, the water turns black (due to formation of metal sulfides). No vegetation can survive within about 10 m of these anaerobic sewage streams. One-time input of BIOSANITIZER near the starting points of eight such natural drains in Pune, resulted in oxygen-rich streams within a few hours. The redox potential was found to improve from minus 300 to plus 100 within a few days. This shows oxygen production. The streams developed a pale green tinge, instead of black color. Bird life started returning. Healthy air also changed the vegetation along the streams, and PMC constructed Nalla Parks along their banks. The construction cost of these Nalla Parks was insignificant because the healthy atmosphere created by the oxygen-rich streams had a tonic effect on vegetation, in particular on the lawn grass. Pune's Mula-Mutha river which carries about 800 MLD of sewage also showed oxygen-rich environment, from which water hyacinth disappeared and healthy organisms (including bird life) appeared. Floating oily layer disappeared and the water surface had mirror-like smooth appearance. The water quality was found to be that of tertiary treated

sewage, though there was hardly any formal sewage treatment through conventional means. This BIOSANITIZER effect has sustained for the past 8 years, in spite of annual floods. The river bed hosts a circus now each year. It has become the most popular spot in the city, because of the fresh oxy-rich atmosphere. One can see the crowd on the food joints there, till midnight. The dry river-bed grows green grass throughout the year, without any irrigation. This suggests that irrigation need of plants increases with the pollution level of air, soil or water. By using the ecosanitation techniques, we can conserve water in agriculture and have more output from a given amount of water. This is easy to appreciate because it is well known fact that organic agriculture is water-conserving, whereas chemical agriculture needs higher amount of irrigation.

Decentralised Sewage Treatment: Ten decentralised sewage treatment projects were set up in and near Pune, to treat the sewage generated by urban buildings and industries. The projects were simple, amounting to applying a one-time dose of BIOSANITIZER in the septic tank. There is no need to de-sludge these units and the oxy-rich water coming out of these units also becomes an asset for gardening and ecosanitation. Its spray helps control odour, pathogens, and pests in the environment. Architects and builders are now coming forward to incorporate sewage recycling in each building, thus reducing the expenditure on sewers and sewage pumping. In fact, sewage recycling has become mandatory in Pune, at least for big buildings (that is, with more than 150 families).

The Centre for Science and Environment, the winner of the Stockholm Water Prize 2005, has produced "A Wastewater Recycling Manual for Urban Areas, with Case Studies" (CSE, 2005). It gives a comparative evaluation of conventional and emerging natural treatment technologies. BIOSANITIZER technology stands out as the most cost-effective, practical, resource-generating technology.

With two running wastewater treatment projects in the USA, and two more under construction, the BIOSANITIZER technology is being launched in the US. The US Environmental Protection Agency and UNICEF have shown interest in the technology.

Total Water Recycle Odourless Public Toilet: Such a toilet that has no water supply and recycles all the sewage for the flushing, keeping it clean, has been working for the past 17 months at Versova sewage pumping station, in Andheri (West) in Mumbai. It is owned and operated by the Municipal Corporation of Greater Mumbai (MCGM). For full details, please see http://www.wastetohelth.com/odourless_public_toilet.html. The sewage treatment is with the help of BIOSANITIZER and uses no machinery/electricity and produces no sludge and greenhouse gases.

Decentralised Garbage Composting Units: More than 10,000 decentralised garbage composting projects have been set up in Pune and other cities, in India. The technology is also exported to other regions such as EU (Ireland) and USA. The method is to apply BIOSANITIZER to clean the groundwater/surface-water (including sewage) and spray the treated oxygen-rich water on the garbage heap each day to ensure eco-friendly bioconversion into compost. It is found that there is absence of odour, pathogens, and pests. There is no heat generation and production of greenhouse gases is minimal. The yield of the compost is about 70%, which is much higher than about 30% when garbage is composted without the use of BIOSANITIZER. The loss is primarily due to higher production of CO₂ in the conventional processes. BIOSANTIZER technology, can thus, avail the carbon credits, making it more cost-effective to the user.

The Petroleum Conservation and Research Association(PCRA), a wing of Ministry of Petroleum, Government of India, has taken up active promotion of decentralised garbage composting, using the BIOSANITIZER technology. It has become important now, to avoid unnecessary transport of garbage and compost and also reduce the consumption of the petroleum feedstock for the production of chemical fertilizers and pesticides. Both these objectives can be met just by recycling garbage into compost, in a decentralised manner, using the BIOSANITIZER technology.

Bio-medical or hospital waste is considered a hazardous waste. Incineration is seen as the safest way to get rid of pathogens and toxic chemicals in it. But one should note that this can only result in the production of higher

amount of nitrogen oxides, carbon dioxide and dioxins (if plastics, such as PVC, also get incinerated along with it). This can produce more health problems to the society by production of toxic rain. Six hospital waste recycling units were installed and operated in and near the Pune city. The Department of Microbiology in Pune's B. J. Medical College evaluated the system for four years and concluded that BIOSANITIZER produced safe compost. Air and soil near the units was also safe. Even viruses such as the hepatitis virus were controlled without any recurring inputs and without producing any air pollution. Avoiding unnecessary handling and transport of the hazardous waste - is the main advantage of this method.

Rainwater Harvesting and Flood Control: Soil has a built-in mechanism to restrict the entry of polluted water into groundwater. Soil, thus, can soak in just 10 mm/d of polluted water. After applying BIOSANITIZER in the surface water pool, one can find that water starts penetrating much faster, upto 1000 mm/d. This was the rain of July 26, 2005 deluge in the Powai-Vihar lake area of Mumbai. One can thus use the BIOSANITIZER not only for treatment of water, but also for effective rainwater harvesting and flood control. One can subsequently use the stored groundwater that is also a resource for ecosanitation.

Treatment of Saline and Brackish Groundwater: About 2,000 farmers and industries have used BIOSANITIZER (refined grade) to treat saline/brackish groundwater. A one-time dose was applied into a well/borewell. BIOSANITIZER granules operate from the bottom and keep on producing oxygen. This drives the natural reactions that convert the salty/brackish water sweet, both for the tongue as well as for the plants. This water also resists scaling, corrosion and growth of pathogens/pests. It becomes a resource for organic agriculture and ecosanitation. The mechanism is similar to that used by the coconut tree in converting saline/brackish water into sweet coconut water.

Treatment of Fossil Fuels: BIOSANITIZER catalyst granules were added in the fuel tanks of stationary/mobile I.C. engines. Several improvements occurred, such as extra mileage, extra engine power, cooler/quieter engine, and lower repair maintenance expenses. The benefits depend upon the fuel quality. The



Retrofitting of Conventional STP using BIOSANITIZER Ecotechnology'

exhaust from these vehicles is cleaner and cooler and also has ecosanitation effect. BIOSANITIZER thus carries out reactions similar to the Vedic yajnya, thus producing healing gases, instead of polluting gases.

Disaster Management: The utility of the BIOSANITIZER technology was well demonstrated after the July 26, 2005 deluge in Mumbai, when it rained about 1000 mm in a day. Accumulated garbage heaps and dead carcasses of animals created sanitation hazards in Mumbai. Special bio-spray was created by combining BIOSANITIZER with a 100 ppm solution of calcium nitrate. This was sprayed on stinking garbage heaps and animal carcasses. The results of ecosanitation achieved were dramatic, as seen by control of odour, pathogens and pests. This was a joint project of Green Cross Society of Mumbai, Bombay Municipal Corporation (BMC) and Indian Express Initiative. The operation was also extended in the jurisdiction of Vasai Municipal Council where dead buffaloes were dumped and their neglect could have created conditions suitable for plague. It was also found that polluted water ponds started generating ripples of oxygen production, within a few minutes of application of BIOSANITIZER granules into the pond. The healthy gases produced healthy growth of food crops in the region, mosquitoes were reduced and the pond water started going down. Nature allows higher percolation rate as soon as the water quality improves. The neighboring well that was heavily polluted soon started producing drinkable water.

Best way to manage disasters; however, is to go to their root cause and prevent their occurrence in the first place. One may say that natural disasters are inevitable. But Eco-Logic tells us that

all unpleasant events serve as warning bells, some also serve to punish us if we refuse to listen to the mild warning bells. They, thus, are all man-made nowadays, and are the indicators of our wasteful habits of neglecting natural resources. If the events are natural, they should occur at the same frequency over the years, like the eclipses. But the hurricanes, earthquakes, forest fires, floods, droughts and epidemics are coming with increasing frequency during this century. Hence, they are more due to human interference, than due to natural causes.

Sir Alfred Nobel found the destructive power of nitrates and created explosives by formulating the nitrates and a triggering carbon compound.

The reaction is almost like a nuclear reaction, the science of it is not well discussed. When we allow the leakage of nitrates in our oceans, groundwater, etc. they work by the same mechanism and produce destructive energy that is visible in hurricanes and earthquakes. One can, now, replace this mechanism with the resource-generating mechanism of the BIOSANITIZER. This way, we not only can prevent these destructive events, but also generate ten times higher value of resources, than the losses that can be inflicted by these events. Forest fires are due to the build-up of nitrates in a forest leaf-litter. Just as the nitrate-rich compost heaps are known to exhibit auto-ignition, the nitrate-rich heaps of leaf litter encourage auto-ignition and start the forest fires. Even a heavy downpour can fail to stop the forest fires. But one can now use the BIOSANITIZER in the forest as pretreatment, few months advance of the summer, or resort to spraying of BIOSANITIZER spray when the forest is already on fire.

Floods are due to increased air pollution, they also are followed by long dry period. Floods and droughts, thus, go hand in hand. One can reduce the air pollution and have a well-distributed rain pattern, that too of low nitrates. This gets readily soaked into the ground, thus avoiding floods. The stored ground-water becomes available as a water-source in the summer and thus avoids the drought.

Emerging epidemics, such as the bird flu are due to overloading our food with nitrates. Each virus needs a bandwidth of nitrates. Only when our body goes into this high bandwidth, we get affected. By using the BIOSANITIZER to treat the animal feed, their drinking water and also by using the BIOSANITIZED water for our drinking, cooking, cleaning, etc... it will be quite easy to stay healthy and not worry about the emerging modern epidemics.

CONCLUDING REMARKS:

Ecosanitation using BIOSANITIZER is more than just cleaning pollution; it turns pollution into resources. It conserves the good components of waste streams, converts harmful ones into useful ones, and produced a resource using the Nature's principles that have evolved on this earth over millennia. The author strongly recommends discontinuing the use of resource-guzzling treatment technologies of the past and use ecosanitation techniques that convert all negatives into positives. BIOSANITIZER is one such solution. **IPIT**

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