Bio-medical liquid waste

Toxics Link
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Concerns and management

An expansion in the number of health facilities across the country and the burgeoning problem of un-treated bio-medical waste had led to the passing of the Biomedical Waste (Management and Handling) rules 1998, but almost eight years down the line, much more needs to be done on the ground.

Handling of bio-medical waste is proving to be an overwhelming challenge for the government and the health sector. However, within the broader theme of bio-medical waste, liquid bio-medical waste is emerging as particularly difficult to handle. Liquid bio-medical waste is far more mobile and moves to a wider area after entering the subsurface water bodies or underground aquifers.

Challenge of liquid bio-medical waste

Most existing systems and technologies being used in handling liquid bio-medical waste are failing to address this problem. For instance, the routine exercise of pouring bio-medical liquid waste is being questioned for posing higher infection threat to medical staff due to its susceptability to spilling, splashing and aerosolising. Liquid bio-medical waste, if untreated, contains a wide variety of material that poses health hazards.

Liquid bio-medical waste standards

According to the *Biomedical Waste (Management and Handling) Rules 1998*, liquid pathological and chemical waste should be appropriately treated before discharge into the sewer. Pathological waste must be treated with chemical disinfectants, neutralised and then flushed into the sewage system. Chemical waste should first be neutralised with appropriate reagents and then flushed into the sewer sysrem.

The treated effluent should conform to the limits shown in Table 1 on the next page.

These limits are applicable to hospitals that are either connected with sewers without terminal sewage treatment plant or not connected to public sewers for discharge into public sewers with terminal facilities, the general standards as notified under the Environment (Protection) Act, 1986 should be applicable.

Section (3) of the Act states: "For the purpose of protecting and improving the quality of the environment and preventing and abating the environmental pollution, the standards for emission or discharge of environmental pollutants from the industries, operations or processes shall be specified in schedule I or IV."

The schedule contains general standards for discharge of effluents. Thirty-five parameters are specified for those to be discharged into municipal sewage.

Minimal safety requirements[2]

Where medical establishments cannot afford treatment of biomedical liquid waste, following measures should be undertaken to reduce risks:

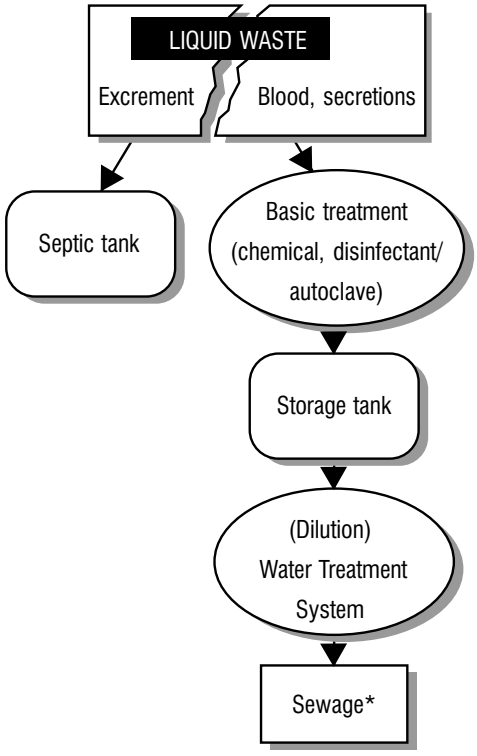
- Patients with enteric diseases should be isolated to wards where their excreta can be collected in buckets for chemical disinfection. This is of utmost importance in cases of cholera outbreaks.
- No chemicals or pharmaceuticals should be discharged into the sewer.
- Sludges from hospital cesspools should be dehydrated on natural drying beds and disinfected chemically (for exmple, with sodium hypochlorite, chlorine gas, or preferably chlorine dioxide).
- Sewage from these establishments should never be used for agricultural, aqua-cultural, drinking water, or recreational purposes.

AT A GLANCE

- **Most existing technologies and practices are failing to deal with the problem of liquid bio-medical waste.**
- **The Environment Protection Act lists 35 parameters for the discharge of effluents into municipal sewage.**
- **Many hospitals, in particular those that are not connected to any municipal treatment plant, have their own Sewage Treatment Plants (STPs) or Effluent Treatment Plants (ETPs).**
- **There is no doubt that liquid medical waste management is a major problem for healthcare facilities and their employees. However, technology and treatment solutions are available.**

Standard Operating Procedures

Liquid bio-medical waste such as blood, mucus, secretions, urine, etc should be disposed through the following procedure.



** Not to be used for cultivation of crops, except for municipal gardening.*

Table 1: Limits of treated effluents

Parameters	Permissible Limits
pH	6.5-9.0
Suspended solids	100 mg/l
Oil and grease	10 mg/l
BOD (3 days at 27°C)	30 mg/l
COD	250 mg/l
Bio-assay test	90% survival of fish after 96 hours in 100% effluent

Treatment of liquid bio-medical waste

On-site treatment or pre-treatment of wastewater

Many hospitals, in particular those that are not connected to any municipal treatment plant, have their own Sewage Treatment Plants (STPs) or Effluent Treatment Plants (ETPs). These plants carry out primary, secondary and tertiary treatment of liquid bio-medical waste followed by sludge treatment.

Hospitals with Effluent Treatment Plants

Himalayan Institute of Hospital Trust

This is a 750-bed hospital near Dehradun and caters to the healthcare needs of 700 villages.

The ETP here was set up on January 2004 at a cost of Rs 2,00,000, with treatment capacity of 100 m3 / day. It is based on aerobic activated sludge process and controls the BOD, COD, pH and total suspended solid. It was set up with the aim of preventing groundwater pollution, energy conservation, meeting water needs and maintaining the ground water table. Some of the treated effluent is recycled as fertilizer for gardens on the hospital premises spread over 300 acres. Some of this is also sold for use in the fields nearby.

The savings in costs and also in the ground water has encouraged the institute to get another STP constructed, which will recycle 2,00,000 litre of water per day. This water will be supplied to the campus and hostels.

Sir Ganga Ram Hospital[7]

Sir Ganga Ram is a 625-bed multi-specialty hospital located in New Delhi. The ETP in the hospital was installed in the basement of the hospital and is operated round-the-clock and is monitored by its maintenance and sanitation department.

The treatment process employed in this system is Extended Aeration, Suspended growth process using fine bubble diffused aeration system.

ETP at Himalayan Institute of Hospital Trust.

Raw wastewater is collected from old and new building by gravity in to the collection tank out side the E.T.P and the raw Influent from laundry comes directly into flocculation tank. From flocculation tank it passes through tube settler for sedimentation process and finally collects in equalization tank for further aerobic treatment done in aeration tank through suspended growth process using diffused membrane aeration system.

The secondary clarification of aerated mixed liquor takes place in Hopper Bottom Secondary clarifier and is followed by chlorination for disinfection. Filtration and de-chlorination of excess chlorine is done using multi grade filter and activated carbon filter. Treated water is then collected in water storage tank. Treated water is reused for flushing and gardening and the treated sludge is subjected to thickening through filter press and used as manures for plants. The results of effluent testing before and after the ETP are given in Table 3.

Choithram Hospital and Research Centre[3]

Choithram Hospital and Research Centre is a 350-bed tertiary care center in Indore, with a daily OPD attendance of 475 patients. . The total water requirement of the hospital is 5,00,000 litres. The ETP plant here was set in November 2001.

The analysis of the hospital effluent before and after treatment is shown in Table 2 all the physico-chemical parameters are within the specified limits. The chlorination results in complete inactivation of the Multiple Drug Resistant bacteria and thus makes the effluent water safe.

The daily input of effluent is approximately 3,39,000 litres and approximately 3,00,000 litres of treated water is recovered. The treated effluent water is used for irrigation and sanitary cleaning. The hospital does not face water shortage any longer. Moreover, more than 5,000 kg. of dried sludge is available every month as manure for its gardens.

Alternative use for biotechnology products[5]

Yashraj Biotechnology Limited is a Mumbai-based company manufacturing diagnostic antigens from native source. It specialises in the field of isolation and purification of native antigenic proteins from biological fluids. Ward fluids in disease state (like ascites/pleural fluids, cerebrospinal fluid), normal state (like post delivery residual blood in cord), urine and donated or rejected blood are collected by the company for isolation of human proteins and native biological markers that are used in manufacture of In Vitro Diagnostics as calibrators and controls.

The collection of these fluids is done in leak proof plastic bottles (duly labeled with biohazard symbol and the company's address) containing preservatives (anti-microbial and protein stabilisers). Once collected the bottles are transported to their manufacturing facility in Mumbai under four layer safety packaging on lines of WHO and US Federal laws. This packaging offers safety at four levels beginning with non-leaking unbreakable bottles, followed by individual secondary self-sealing bag, jumbo bags, hard plastic container secured an sealed with strips.

Any leftovers are chemically disinfected using one percent hypochlorite solution and disposed in CETP lines, as per guidelines in *Biomedical Waste (Management & Handling) Rules, 1998*. They are authorised by MPCB for these activities under contract with Mumbai Biomedical Waste Management Co. Records are maintained for such activities. The company does not offer any monetary benefit to the hospital and participation is completely voluntary.

Best management practices for liquid bio-medical waste management

- Medical establishments in remote locations should provide for minimal treatment of wastewater through affordable means (for examle, use of lagoons to achieve an acceptable level of purification, followed by infiltration of final effluent to the land).
- Sewage containing such waste should never be used for agricultural or aquaculture purposes.
- Sewage should not be discharged into or near water bodies that are used for drinking water.
- A mercury spill kit should be at hand and staff should be trained to recover the spill using correct techniques.
- A properly sized grease interceptor should be installed and maintained to reduce the discharge of oil and grease from kitchen and food preparation areas to the sanitary sewer system.

Table 2: Physico-chemical and bacteriological analysis of effluent water

Parameter	Value before ETP	Value after ETP	Limit
Total viable bacterial count	9 X 104	Nil	-
MDR Coli-form [%]	1.5	Nil	Nil
Chem. Oxygen Demand [mg/liter]	280	22.56	<250
Biological oxygen demand	45	3.6	<30
Total Solids	1066	630	<2200
Total dissolved solids >mg/ltr.	942	630	<2100
Total suspended solids mg/ltr.	124	<2	<100
pH	7	8.8	6.5-9

Table 3: Physico-chemical and bacteriological analysis of effluent water

BEFORE					AFTER
Parameters	**Domestic**	**Laundry**	**Kitchen**	**Boiler**	**Entire Building**
Peak flow Kl/day	385	75	30	10	
Oil & Grease mg/L	10-20	50-75	150-175		<1
Suspended solids mg/L	100-150	150-200	300-400	200-250	<1
B.O.D. mg/L	200-250	100-150	500-600	20-30	6
C.O.D. mg/L	400-600	600-800	1000-1100	40-50	29
pH	-	-	-	-	7.3

Type of biological fluids collected for various antigens/proteins[4]

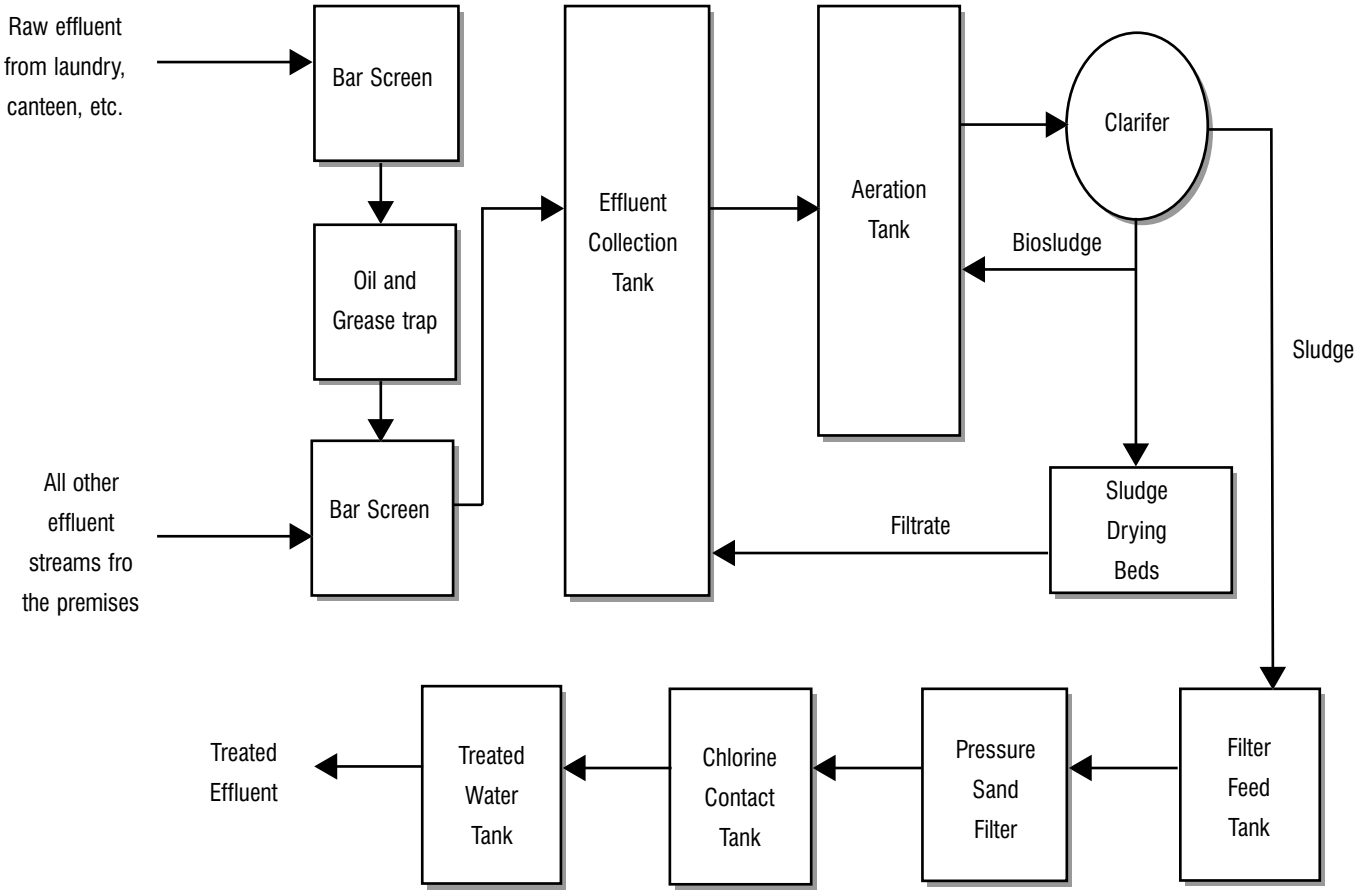
Source Material	Antigen/Protein Extracted
Human Ascitic/Pleural Fluid	C Reactive Protein (CRP)
Human Cancer Ascitic/Pleural Fluid	Cancer Protein 15-3, 19-9, 125, 72-4
Human Urine	Beta 2 Microglobulin (B2M)
Human Meconium	Carcino Embryonic Antigen (CEA)
Human Cord Blood	Alpha Feto Protein (AFP)
Human Blood	Hepatitis B surface antigen ad and ay
Human Seminal Fluid	Prostrate Specific Antigen (PSA)
Human Leukocytes	Myeloperoxidase (MPO), Proteinase 3 (PR-3)

- Where feasible, solvents should be recovered for reuse.

There is no doubt that liquid biomedical waste management is a major problem for healthcare facilities. However, technology and treatment solutions do exist.

These solutions, combined with proper training in handling of waste will enable healthcare organisations to diffuse this critical problem while safely, and cost effectively, managing their liquid biomedical waste.

Figure 1: Schematic flow sheet of Effluent Treatment Plant[3]



References and suggested reading

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Compiled and written by ***Yamini Sharma***
with inputs from the ***Toxics Free Health Care team***

For more information, please contact:

info@toxicslink.org
Toxics Link
H2 Jungpura Extension
Ground Floor
New Delhi 110 014
Tel: +91-(0)11-24328006/0711
Website: www.toxicslink.org

Designed and produced by Splash! Communications, *e-mail* makeasplash@vsnl.net