

Effluent to Affluence: Value addition of Hospital and Industrial waste

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Sustainable management of a clean and healthy environment is the basic criterion stipulated for various accreditations for Ayurveda hospitals and Medicine manufacturing industry. Among the core sectors, waste management poses a significant agenda in any clinical or industrial setup. For the effective management of wastes, implementation of Effluent Treatment Plant, Sewage Treatment Plant, Biogas Plant, Incinerators are promoted in large scale production units and in most of the hospitals as the case may demand. Currently waste disposal practices are creating lot of environment hazards like air pollution, water pollution and soil pollution. Generation of biogas from kitchen wastes and kashaya sediments are practised in various hospitals. Irrational dumping of medicinal sediments from various preparations and disposal of waste water without any pre-treatments may affect the fertility of the soil and quality of water in open wells and natural reserves. Open incineration of hospital and industrial wastes may affect the air purity in varying degrees. In this context, it is a matter of great significance that effective waste management programmes are available to develop value added products from Ayurvedic Hospital and Industrial wastes. In Ayurvedic hospitals, wastes generated are from various sources like food, effluent water after oily bath, sediments of various medicinal preparations, wastes from various poorvakarma-panchakarma procedures, biomedical wastes from para-surgical procedures and laboratory practices, human wastes, HDPE / PET bottles, LDPE covers. The waste generated from Ayurvedic manufacturing industry is unique which mostly consists of a complex mix of solid wastes from the preparations like kashayam, asava-rishtam, lehyam, ghrutham, thailam, gulika. Sediments after juicing, wastes after raw material cleaning, waste water left after utensils and machinery cleaning which usually contain lipid matters, sugars etc.

According to this author's observations, the industry and hospitals could initiate and promote advanced protocols and activities for the management of solid and liquid wastes for developing value added products such as fuel briquettes, organic manure, enzymes like lipase, protease, amylase etc, ethanol, inoculums, bio-gas, adhesives, single cell proteins, cattle feed, bio-fuel, electricity, fertilizers, etc. Efficient and value added bio-medical waste management program is compulsory for definitive

accreditations. Ayurvedic hospitals being categorized as 'Orange' by Pollution Control Board, there's an urgency to categorize it as 'Green' pretty much like how the nature is expected to be sustained. Starting with green - herb based products, treatment & dietetics, conversion to organic manure and ending with green - Green categorization and keeping the premises evergreen is to be focused and prioritized in hospital waste management activities.

Food wastes: In Ayurvedic hospitals vegetarian food is preferred for patients during hospital stay. But the by-standers might procure and eat non-vegetarian food stuff in the hospital premises. For the effective management of food wastes of all types, various types of composting and bio-gas methods are suggested. The safest mode recommended is composting by utilizing various micro-organisms. This results in the production of enriched liquid and solid manure of higher quality and could be readily utilized for reinforcing medicinal plants garden or vegetation in the homesteads. Biogas method has certain limitations in the continued efficiency and maintenance.

Effluent water: Waste water from an Ayurvedic hospital is different from other hospitals. It contains oil, herbal sediments, starchy wastes etc. that may adhere to the drainage system often blocking / clogging the water closets. De-oiling the wastes in used water and converting it to useful products are offered but it should be conducted according to the nature of the effluent. This water could better be recycled as water for irrigation.

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Sediments of various medicinal preparations: Freshly prepared kashayas are the unique formulations prevalent in Government owned Ayurveda dispensaries and hospitals, especially in the State of Kerala. In some hospitals, products/ formulations required for special treatments are prepared as made to order. Sediments generated after various processing methods could be managed through anaerobic composting methods. In some centers, incineration is followed which might create minimum environmental contamination.

Treatment wastes: This group includes solid wastes from various kizhi processes, semi-solid waste from njavarakkizhi and navara theppu, Vomitus, liquid waste i.e oil after pizhichil, sirovasthi, sirodhara, thakradhara, etc. Solid and semi-solid group could be considered for lipid waste management or microbial composting. 'Oil waste' management is a special area, for which various treatment procedures are available. Research activities are in progress for generating bio-fuel from oil wastes, conducted at various academic institutions.

Human wastes: From human wastes, biogas can be easily generated. The biogas could be utilized for heating oils or frying leaves etc related with various swedana processes in an ayurvedic clinical setup. Power generation is also tried, tested and found as an effective value added domain. Hence, energy saving is the final outcome of human waste management. But the excreta after vasthi karma contains oil matter. Prior treatment like de-oiling may be conducted on such wastes as the first step. Proposal of biogas plant in this segment can be modified to address this issue.

Plastics: Pelleting of plastic waste for manufacturing door lockers and switch boards, recycled to meet material for road tarring is getting popular in recent times. Proper collection and recycling of plastics will keep the environment and ultimately, the earth a safe to live in.

Biomedical waste: Biomedical waste is any kind of waste containing infectious (or potentially infectious) materials. Biomedical waste may be solid or liquid. Waste generated through para-surgical practices like, kshara soothra, raktamoksha, laboratory waste etc. need to be considered in this category. BMW practices adopted by modern hospitals under strict control measures of Pollution Control Board could be incorporated in AYUSH systems as well.

Industrial wastes: Four types of wastes are generated from Ayurvedic medicine manufacturing industry. Wastes from raw material cleaning (cleaning of thathiripoovu, jeeraka, etc, semi-processing /medicinal purification i.e. wastes after juicing, guggulu purification and in-process i.e Paneer after the preparation of whey, meat waste after soup preparation, half boiled yava etc), decoction wastes, wastes from oils and lipid preparations and fermentation

wastes. Kashaya wastes could be recycled to ash, fuel briquettes, organic manure, base for mosquito coils, adhesives for water treatment (Charcoal) etc. Oil and lipid wastes are found to be excellent sources for various enzymes like lipase, protease etc and they could also be recycled for the production of good manure. Asava-arishta waste is the best and safe source for initiating fermentation. Comparative study on yeast and the fermentation waste has shown better results for the later. Advanced studies on fermentation wastes for single cell protein are in progress and its safety screened by various biotechnology / molecular biology techniques to promote it for popular use.

On the basis of observations and experience of this author on various waste management programs in Ayurveda hospitals across Kerala, anaerobic microbial composting like ring composting and the 'thumboormoozhi' model are found to be the best cost effective methods. The entire waste except plastics and human wastes and liquid wastes could be well managed through those methods. For oil waste management advanced studies in biofuel generation need to be conducted. The medicine manufacturing industries could implement thumboormoozhi model and Wind Row model for the production of organic manure. The same could be utilized for the cultivation of medicinal plants and sold to farmers with quality certification. Support from Suchithwa Mission - Kerala Agricultural University is available for technical assistance and implementation. Collaborative research programmes for the management of industrial waste has tremendous scope for the development of value added products.

Since the country is looking for organic cultivation programme, the organic nature of Ayurvedic hospital and industrial wastes could be effectively introduced in the main stream. Soil fertility, levels of micronutrients pH etc. could be maintained for a better version of agro-technology in this domain. Initiation and implementation of collaborative research projects with Agriculture department, Kerala Agriculture University, streams like Environment Engineering, Industrial Engineering, Chemical Engineering, Biotechnology, Microbiology Molecular Biology, could support Ayurveda sector to create decent wealth from wastes at workplaces.