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**ADVANCES IN SLUDGE MANAGEMENT**

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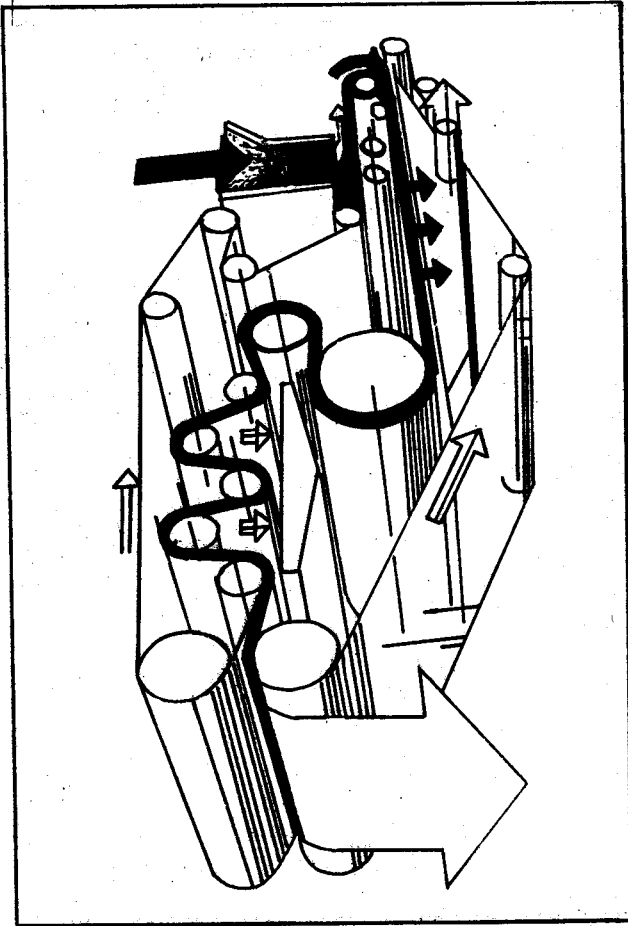
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**Abstract:**

Paper Mills are going to increasingly face problems in disposal of Sludges. With the emphasis on re-forestation, composting sludges is the best alternative in the National interest. Tunnel Reactor is the latest technology to convert sludges into compost. Tunnel Reactor is being made in India now, with German Collaboration.

One of the most troublesome problems facing the pulp & paper industry is sludge disposal. Most sludges are thin aqueous suspensions of waste material. Their makeup generally depends on the type of mill, whether it is waste-paper based, agro-based etc. Sludges are at present being sent to sludge beds by most mills, and occupy a lot of land and are unpleasant to manage.



Some mills attempt to dewater sludges by mechanical means, like centrifuge, vacuum methods or belt filter press. One of the latest method for doing the same is given in the diagram below.

This is the latest type of belt filter press introduced in Europe recently, and can dewater sludges with solid content as low as 0.5%, thus eliminating the need of pre-thickener.

Sludges are hard to dewater because of the hydrous nature of the fine pulp fibres that form their main organic constituent. These fibres are highly swollen and have almost colloidal gel structure. The freeness of the fibres is low because of intrinsic hydrophilicity of the fibre polysaccharides, cellulose, and hemicelluloses. The situation is aggravated by kaolin, pigments, starches, dextrans, and similar materials.

Disposal by combustion of sludge cake, either dewatered by mechanical means or by drying in sludge beds, is seldom convenient or economical. Auxiliary fuel is often needed to dry the sludge cake enough to maintain good combustion, while clinker from clays causes fouling of furnace grates. Disposal by wet oxidation has generally proved too expensive.

Most mills therefore practice disposal by landfill. It may, however, become increasingly difficult and costly to obtain and maintain ample sites for landfilling. Some legislation in this regard in near future cannot also be ruled out.

Some of this regulation may be about

- (a) questions of soil stability
- (b) land use
- (c) spoilage of land by formation of impenetrable clay sticks
- (d) poor drainage in some areas that causes uncontrollable runoff and related pollution phenomena.

There is therefore a need for new and effective methods of sludge disposal. One possibility is to convert sludge into useful products. Efforts to convert wood & wood industry wastes into useful products by chemical means, eg. by acid hydrolysis, have seldom proved economically successful. The same situation prevails with pulp mill tailings. However, biological conversion of the organic constituents of sludge offers some novel and ecologically attractive alternatives.

## **Biological Approach and Tunnel Reactor**

The swollen gel like nature of fibres in pulp & paper mill sludges makes them highly amenable to attack by micro-organisms. Dewatering is required for Tunnel Reactor. Success in biological treatments depends on the ability of micro-organisms to convert pulp fibres rapidly. The rate at which fibres are attacked depends on their lignin content. The intimate admixture of lignin presents physical barriers and metabolic blocks to enzymes. Consequently, rotting of wood from white rot fungi and brown rots, is normally slow.

Organisms more active than fungi are available in the form of bacteria. The potential of bacterial degradation of sludges therefore is promising. Many, so called 'thermophiles' act at high temperatures, giving high turnover rate. Tunnel Reactor exploits this avenue for converting sludges to compost.

### **Process**

Tunnel reactor, is an in-vessel composting system which provides a totally enclosed, controllable environment for accelerated, aerobic decomposition of organic matter.

It is designed to maintain a high degree of biological activity in the thermophilic range. The Tunnel Reactor is divided into 7 aeration zones. The dewatered sludge after mixing with a certain amount of recycled compost, is dropped into the Tunnel every day. The hydraulically operated door then pushes the material. At the bottom of the Tunnel Reactor there are a number of diffusers which are individually controllable. The temperature feedback control system automatically regulates the airflow, to maintain the optimum biological activity. The system ensures that the material is subjected to the quickest route to composting. The end product is considerably reduced in volume and weight compared to the original sludge and emerges out as perfect friable composted material.

Tunnel Reactor, itself, is very simple and has no moving parts. It is very reliable mechanically, and is only 12 feet high. The German Collaborators, namely BAV Anlagenbau GmbH have been engaged since two decades in manufacturing and supplying composting plants. Their design of Tunnel Reactor is proving to be an excellent design.

A diagram of Tunnel Reactors is given. They are made in eight standard sizes. Some unique features of Tunnel Reactor are listed below:

- Simple design
- Minimal investment
- No moving parts within the reactor
- Very low repair and maintenance costs
- Low energy costs
- Heat recycling possible, using heat created by the micro-biological action
- Freedom from noxious emissions into atmosphere
- Good control of microbiology
- All automatic operation possible
- Modular system of construction permits any size of system to be designed.

**Tunnel Reactor Compost**, in contrast to sludge, is a highly structured material similar to humus or peat mosses. It actually improves the structure and friability of soil and its ability to absorb and hold water, thereby reducing runoff & erosion. In fact, by the addition of composted wastes, otherwise non-arable land can be brought under forestry or cultivation. Thus the composted material should be used as a soil conditioner, as it improves soil structure and aeration, enhancing plant growth.

In our country, the population growth is steadily decreasing per capita availability of arable land. This will require intensive agriculture of land, which will not be possible from artificial fertilisers alone, but will be possible by application of compost as a source of humus to the soil. Humus, as we all know, cannot be artificially produced.

Our country is also losing top soil due to erosion, after uncontrolled felling of forests. Forestry has to be practiced urgently, for conserving climate, water, soil and reclaiming degraded acreage.

By composting their sludges pulp & paper mills will be contributing towards a social goal and also recycling to earth, something they had taken away.

