



# Trainers Training Program on Waste Management in Textile & Garment Industry in BGD

Promotion of Sustainability in the Textile and Garment Industry in Asia - FABRIC



**GIZ FABRIC – Waste Management Course**

# Presentation 7: Sludge disposal



## Contents



Guidelines on disposal of sludge from textile ETPs.



Disposal options not permitted at present : composting, brick manufacture, land conditioning/manure.



Disposal options allowed at present for all sludge and those within category B: secured landfilling and co-processing.



Other options: Incineration, pros & cons, economic viability.



Recommendations & way forward.

# Guidelines on disposal of sludge from textile ETPs.



# Wastewater and effluent treatment – Basic terms



- Wastewater treatment = removal/reduction of contaminants/undesired components in spent water from an operation to ensure its **safe release to environment or reuse**.
- **Domestic wastewater** (also called municipal wastewater or sewage) treated in sewage treatment plant (STP)
- Wastewater (effluent) from industrial operations treated **industrial wastewater treatment plant** or **effluent treatment plant** (ETP)
- Effluent treated in
  - **individual ETPs** or
  - **common ETPs** (CETP), often for a cluster of industries.

# Sludge Categories – Bangladesh



Increasing hazardousness  
for human health and the environment.



**Category A:** Municipal sludge from domestic or urban waste waters only.

**Category B:** Sludge from industry, including sludge from CETP\*.

**Category C:** Sludge from industry belonging to a hazardous waste category including sludge from CETP.

Exhibits one or more hazardous characteristics such as high flammability, explosive property, oxidizing property, poisonous, infectious etc.

# Sludge Categories – Bangladesh



**Increasing hazardousness  
for human health and the environment.**

Treatment and disposal options Option	Sludge category		
	A	B	C
Anaerobic Digestion (Co-Fermentation)	X <sup>1</sup>	X <sup>1</sup>	**
Aerobic Digestion (Composting)	X <sup>1</sup>		
Agricultural Use	X		
Controlled Landfill*	X	X	X
Thermal incineration	X <sup>1</sup>	X <sup>1</sup>	X <sup>1</sup>
Land application (filling material, e.g. for flood prevention)	X	X <sup>2</sup>	**
Recycling in brick, cement or asphalt manuf.	X	X <sup>3</sup>	**

<sup>1</sup>Residues will remain that have to be disposed of, fulfilling the requirements applicable to the category, on an alternative route e.g. by landfill.

<sup>2</sup>Inert material (low organic matter required)

<sup>3</sup>Availability and capacity limited by local conditions. Accepted sludge volume limited due to a loss of compressibility of the product

\* Requirements for the landfill class (Chapter 3.3.4) vary depending on category of the sludge.

\*\*As described in Chapter 2, the producer may provide evidence that sludge categorized as category C sludge according to Annex 1A or 1B does not possess any hazardous characteristics; in this case it may be categorized as category B sludge and the management options of anaerobic digestion (co-fermentation), land application (filling material e.g. for flood prevention), recycling in brick, cement or asphalt making are permissible.

# Sludge Characterization

**Parameters needed to be tested before deciding on any sludge disposal application**



<b>Priority</b>	<b>Parameters</b>
<b>Primary Parameters</b>	<b>Total Organic Carbon (TOC)</b> <b>Moisture Content</b> <b>Calorific Value</b> <b>Heavy metals: Cr, Cd, As, Pb, Cu, Ni, Hg, Zn</b> <b>Sulphur Content</b>
<b>Secondary Parameters</b>	<b>Organohalogen</b> <b>Polychlorinated biphenyl (PCB)</b> <b>Polychlorinated dibenzodioxin (PCDD)</b> <b>Polychlorinated dibenzofuran (PCDF)</b>



# Sludge Characterization

Threshold differentiates by categories A, B and C. Range of parameter values can be considered to determine the sludge category.

To simplify classification approach, acceptable limits for major sludge quality parameters defined in the Guideline for Sludge Management in Bangladesh Textile Sector



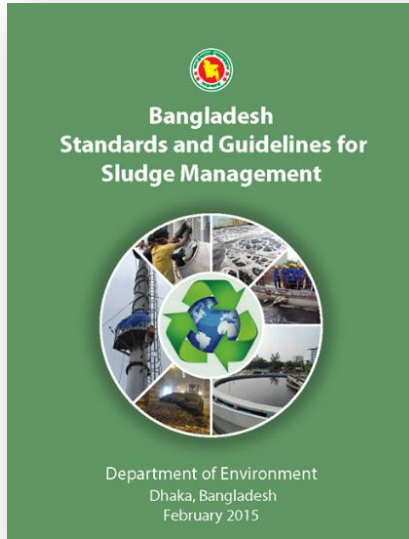
Parameter	Unit	Category A	Category B	Category C
As	mg/kg	$\leq 40$	41-75	$> 75$
Cd		$\leq 10$	11-85	$> 85$
Cr		$< 600$	$< 600$	$> 600$
Cu		$\leq 800$	801- 4,300	$> 4,300$
Pb		$< 840$	$< 840$	$> 840$
Ni		$\leq 200$	201-420	$> 420$
Zn		$\leq 2500$	2,501-7,500	$> 7,500$
Hg		$\leq 8$	9- 57	$> 57$

# Sludge Disposal Options



- Some of the options such as agricultural use or direct land application are not applicable for sludge from most textile ETPs.
- In the Bangladesh Standards and Guidelines for Sludge Management, applicable disposal options for various categories of sludge are discussed.
- Manual for Sludge Management in Bangladesh Textile Sector focuses on the textile sludge disposal.

# Sludge Disposal Options



## Generalized guide for selecting suitable sludge disposal option

Disposal Options	Sludge Category			Bangladesh Scenario
	A	B	C	
<b>Anaerobic digestion (co-fermentation)</b>	X*	X*	X <sup>¥</sup>	Pilot Trial
<b>Aerobic digestion (composting)</b>	X*			Need to be tested before application
<b>Agricultural use</b>	X			Need to be tested before application
<b>Controlled landfill<sup>Ψ</sup></b>	X	X	X	Not yet started but easily implementable
<b>Thermal incineration</b>	X*	X*	X*	Pilot Trial
<b>Land application</b>	X	X <sup>#</sup>	X <sup>¥</sup>	Commonly practiced
<b>Recycling in brick, cement or asphalt making</b>	X	X <sup>§</sup>	X <sup>¥</sup>	Formal and informal brick trial, pilot trial to make Compressed Stabilized Earth Blocks (CSEB).

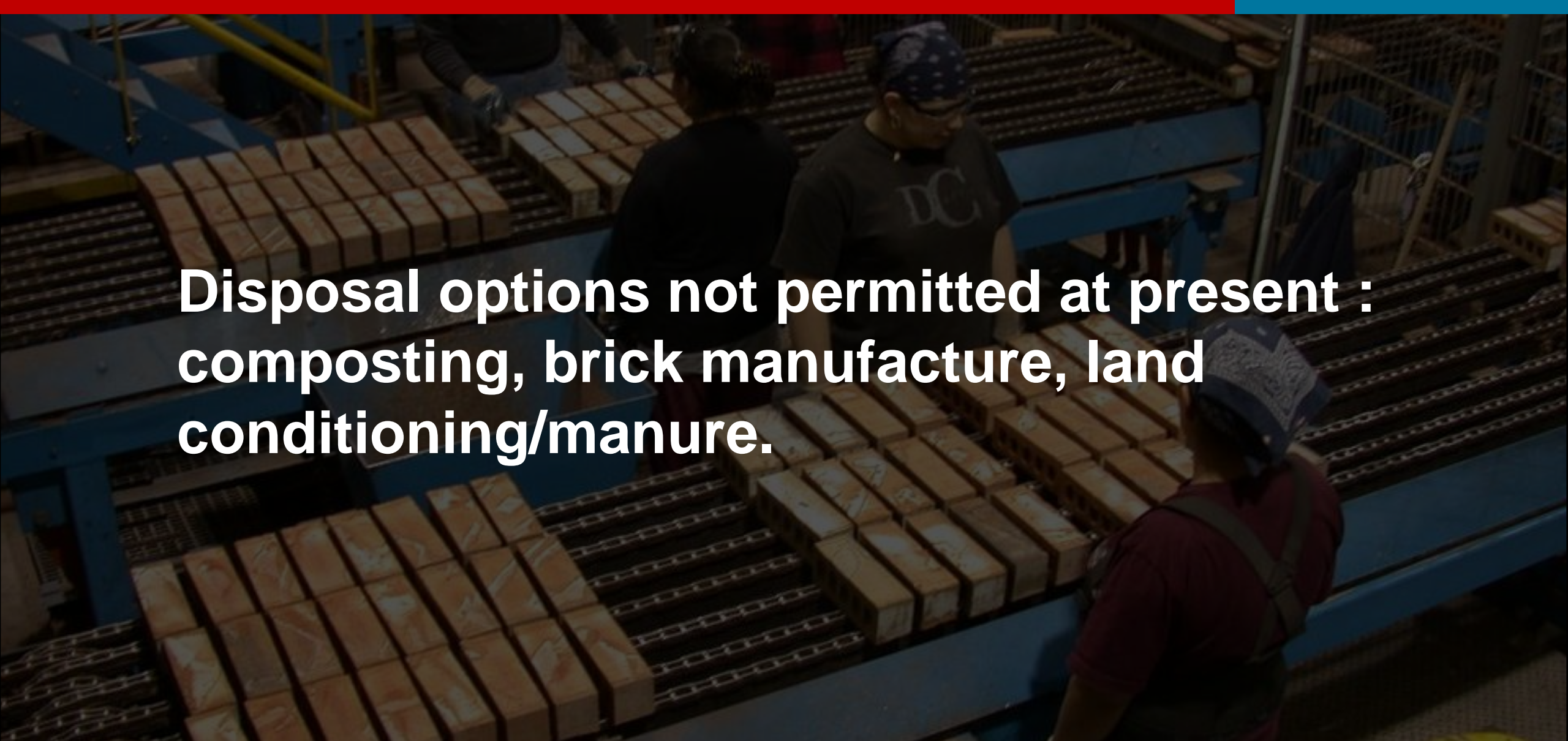
\* Residues will remain that have to be disposed of, fulfilling the requirements applicable to the *Category*, on an alternative route e.g. by landfill.

# Inert material (low organic matter required)

§ Availability and capacity limited by local conditions. Accepted sludge volume limited due to a loss of compressibility of the product

Ψ Requirements for the landfill class vary depending on *Category* of the sludge.

¥ The producer may provide evidence that sludge categorised as *Category C* sludge according to Annex 1A or 1B of Standards and Guidelines for Sludge management does not possess any hazardous characteristics; in this case it may be categorised as *Category B* sludge and the management options anaerobic digestion (co-fermentation), land application (filling material e.g. for flood prevention), recycling in brick, cement or asphalt making are permissible.

A photograph of a brick factory. In the foreground, a worker in a red shirt and a blue cap is seen from the back, looking towards a conveyor belt. The conveyor belt is moving several stacks of light-colored bricks. In the background, another worker in a dark shirt and a blue cap is visible, also working with the bricks. The factory environment is industrial, with metal structures and conveyor belts.

**Disposal options not permitted at present :  
composting, brick manufacture, land  
conditioning/manure.**

# Direct land application and Controlled Landfill



© Nogales International. *No flags raised by landfill sludge study.*, 2015

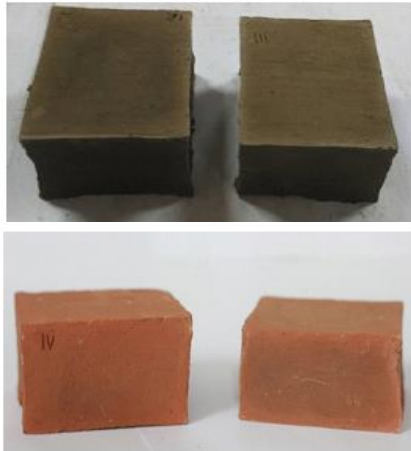
Land application (uncontrolled land filling) refers to a wide variety of uses such as filling material for flood prevention, material/ substrate for re-cultivation of mining sites, or covering landfill sites.

This is mostly suitable for category A sludge.

Category B and C can be considered for this application if the requirements are fulfilled

- Any specific land application of sludge requires prior permission from the Soil Resource Development Institute (SRDI) and the Department of Environment (DOE).

# Recycling in Brick Manufacturing



There are around 8,000 operating brick kilns in Bangladesh.

The use of sludge in the construction industry is environment friendly and reduces the usage of topsoil.

Sludge with **decent heating value also reduces the energy consumption** compared to the regular brick making process.

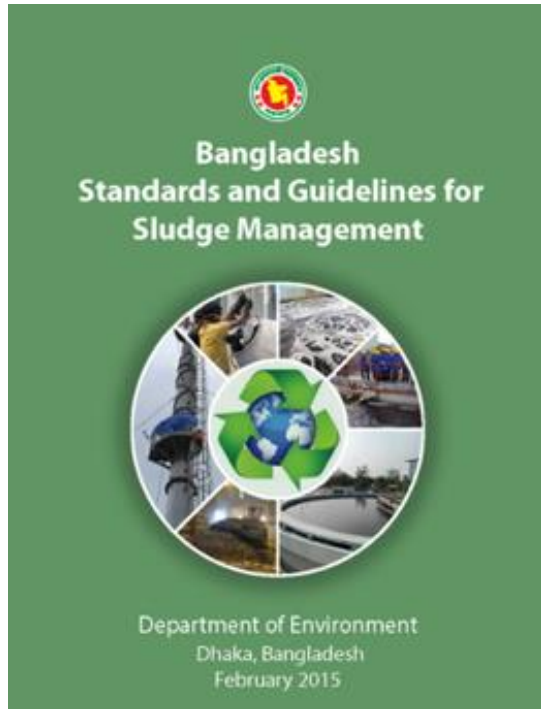
**Lower moisture content and lower organic content** are required for this application.

Due to presence of heavy metals in textile sludge, leachate study is necessary for optimum mixing.



**Disposal options allowed at present for all sludge and those within category B: secured landfilling and co-processing.**

# Sludge disposal requirements in Bangladesh



- Sludge from textile ETP considered hazardous requiring special disposal.
- **Sludge guidelines** adopted by DoE of Bangladesh:
  - Three groups of sludge categories (A, B, C)
  - Category A only for municipal sludge; remaining sludge either B or C based on concentration of heavy metals.
  - **Sludge from textile ETPs mostly category B** but also **some in category C**.



# Sludge disposal requirements in Bangladesh



Sludge incinerator

## Disposal requirements for category C sludge

- **Secured landfill** with multiple layers of liners, leachate collection & treatment, capping on filling; costly, land requirement, non renewable.
- **Incineration** feasible, but costly, need for disposal of ash, logistics arrangements.
- **Co-processing** of category B & C for making construction materials,
- in Bangladesh only one co-processing company (Geocycle).

# QUIZ!

**Which disposal options are allowed for textile wastewater treatment sludge at present in Bangladesh?**

- Composting
- Secured landfill
- Brick manufacturing



**Other options: Incineration,  
pros & cons, economic viability.**

# Thermal Incineration and Co-incineration



Sludge incinerator

- The purpose of incineration is to destroy the organic material from any type of sludge (Category A, B or C).
- Conventional incineration process **generally consumes more energy than it produces**.
- Not a good disposal option for sludge with **high moisture content and low calorific value** (Category A).
- Drying sludge and **mixing it with other waste** is a viable option for generating energy.
- High incineration temperature prevents generation of toxic chemicals such as dioxin and furan.

# Economic viability of co-incineration



Sludge incinerator

- Co-incineration of textile sludge in the cement industry is popular over the world where wastes are destroyed at a higher temperature and longer residence time.
- It makes the incineration more cost-effective and reduce the chances of forming toxic gases.
- Geocycle, in collaboration with LafargeHolcim Bangladesh limited, has initiated sludge co-incineration in Bangladesh in 2012.
- Basic sludge requirements for co-incineration are the same as thermal incineration.

# Thermal Incineration and Co-incineration



- The use of textile waste water treatment sludge by co-incineration in cement plants costs between 30 and 80 EUR / t
- The sludge for co-incineration should have a water content of max 65 % (min. 35 % dry substance)
- The cost depends on the transport costs and the eventually necessary pretreatment like drying, grinding, mixing with other AFR or fuels.

# Group work



**10 min Group Work, please document your results**

Discuss your experience with wastewater treatment sludge handling.

What were your challenges?

What solutions have you found to assure a compliant solution?

# Recommendations & way forward.



# Recommendations



- To reduce the hazardous chemicals load of the treatment sludge by substitution of hazardous chemicals in the finishing processes, the sludge category could be brought down to B or even A. This would allow less sophisticated discharge options, like brick manufacturing.
- The use of hazardous chemicals can be avoided or at least be reduced by the application of Best Available Techniques (BATs).
- The successful use of environmental sound practices and chemicals can reduce the hazard potential and lead finally to a recategorization of the textile wastewater treatment sludges.

# Possible future steps forward



**The following indicated new technologies may allow the on site incineration of sewage sludge**

**Huber sludge 2 energy system**

<https://www.sludge2energy.de/de/unternehmen-s2e>

or

**Reduce the sludge production to a large extend like**

**SeaChange waste water evaporator**

<https://seachangetechnologies.com/>

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