# Sustainable sludge management strategy at water and wastewater treatment works

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## Keywords

Sludge disposal; management options; sustainability;

## Sustainable Development Goals Link

Clean water and sanitation (Goal 6); Sustainable Cities and Communities (Goal 11)

## Background

Disposal of water and wastewater treatment works sludges is a challenge experienced by water boards and municipalities across South Africa. Current practices include the stockpiling of sludge on site or disposing at a landfill site. The project team investigated sustainable sludge management methods at different wastewater treatment works in Kwa-Zulu Natal and the Eastern Cape. This paper serves to present the key findings from the investigation.

*Note: Water treatment sludges are known as residues, but for the purpose of this paper all sludges regardless of source shall be termed as 'sludges'.*

### Highlights

- Sustainable management of water and wastewater sludges is a challenge experienced across South Africa.
- Disposal of sludge on site may provide the lowest cost option but is not seen to be sustainable and has environmental and regulatory concerns.
- Reusing and recycling of sludge as compost, bricks or briquettes are seen to be sustainable management options but require an off-taker and will also need to adhere to key regulatory requirements[1].
- Recovery of energy from sludge can reduce electricity costs on site, but it does require a larger capital outlay.

## Methodology

[1] Reference is made to the Guidelines and Utilisation of Wastewater Sludge (TT 261/06). DWS stipulate in the authorisation of the treatment plant that the Guidelines should be adhered to and through this process the Guidelines become legally binding.

Sludge samples were collected from the water and wastewater treatment works and were analysed by SANAS accredited laboratories.

The following accreditation challenges were encountered within the project:

- SANAS accreditation is granted on a test by test basis and not bestowed upon the entire testing facility;
- Not all laboratories are SANAS accredited for a comprehensive battery of waste classification tests and samples had to be taken to other laboratories;
- There is no laboratory in South Africa that is accredited to undertake analyses for 2.4 D (pesticides) and this test had to be undertaken in the UK.

Samples were assessed and classified in terms of the General Norms and Standards, National Gazetted Regulations and the Sludge Utilisation Guidelines.

A Sludge Disposal Options Analysis Model was developed to enable the comparison of the available management options. The model highlighted the financial and strategic implications, and the risks to be mitigated for each option.

## Results and Findings

The management options and findings of the study can be summarised as follows:

***Table 1: Management options and findings***

| Management Option | Findings |
|---|---|
| On-site disposal | May result in the lowest cost but is not sustainable due to space considerations and potential environmental risks.<br>Need to ensure that all regulatory approvals are in place. |
| Disposal at appropriate landfill site | Costs for this option are driven by volumes to be disposed and distance to the landfill site. Landfill sites will also charge a fee for disposal.<br><br>Current legislation (effective as on 23 August 2019) in terms of the National Environmental Management: Waste Act confirms that sludge is prohibited to be disposed off at a registered landfill with a moisture content of >40%.<br><br>The current dewatering mechanisms achieve at best a 8-12% sludge moisture content. This poses a massive challenge for municipalities going forward as sludge drying technologies will need to be implemented. |
| Application to agricultural sites within 50km of the wastewater treatment works | Sites with a suitable crop will need to be identified and engaged to secure off-take.<br><br>Additional studies are required taking into consideration environmental legislation, legal aspects and market appetite.<br><br>Monitoring will also be required. |
| Composting at a central composting facility | Can be applied to a wider variety of crop as compared to sludge. Costs will be driven by proximity to wastewater treatment works and ability to identify and secure an off-taker.<br><br>Additional studies are required taking into consideration environmental legislation, legal aspects and market appetite. |
| Thermal sludge management (incineration) | High capital outlay is required but this could be offset by the savings made in energy savings at the works. |
| Used as a raw material to manufacture bricks/briquettes | Costs will be driven by proximity to wastewater treatment works and ability to identify and secure an off-taker |

## Conclusion

The figure below assists in highlighting the key conclusions of the study from a sustainability view and a bottoms-up approach (i.e. the top being the preferred position):

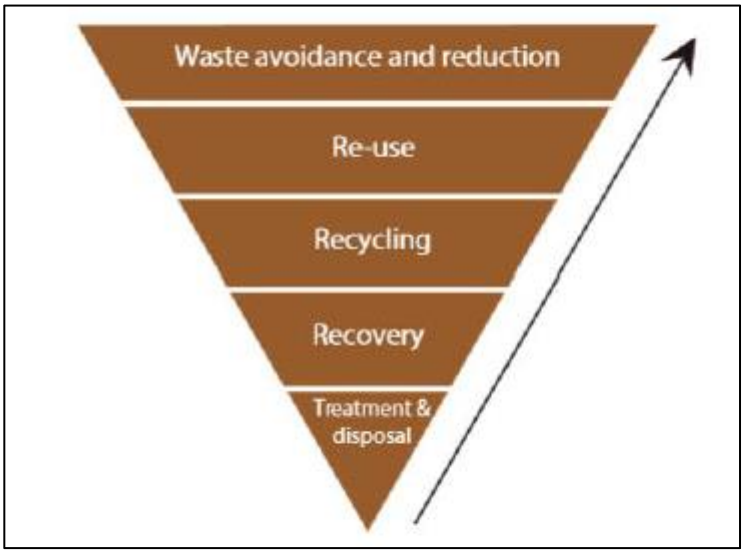


***Figure 1: Waste Management Hierarchy as per the National Waste Management Strategy***

**Avoidance and reduction:** Water and wastewater sludge is a part of the treatment process but the point of departure in any sludge disposal strategy should be the reduction of sludge to be disposed. This can be done by employing a variety of dewatering options.

**Re-use:** Sludge can be applied to agricultural land but an off-taker is required. Monitoring of the application of the sludge is required.

**Recycle:** Sludge can be recycled into other products such as compost, bricks and briquettes. An off-taker is a crucial requirement for this option.

**Recovery:** Energy from sludge can be recovered for use at the wastewater treatment works through incineration. High capital outlay but will present a savings in the consumption of electricity.

**Treatment and disposal:** “Last resort” in the waste management hierarchy. This should only be explored after other more sustainable options have been explored.

The diagram below provides an indication of the cumulative lifecycle costs for the different dewatering technologies which includes the disposal of sludge at a landfill from a 24 Ml/day wastewater treatment works. Note that current legislation deals with disposing of sludge to landfills only, unless there is adequate storage on site in terms of the regulations (i.e. lining of disposal area and licenses).

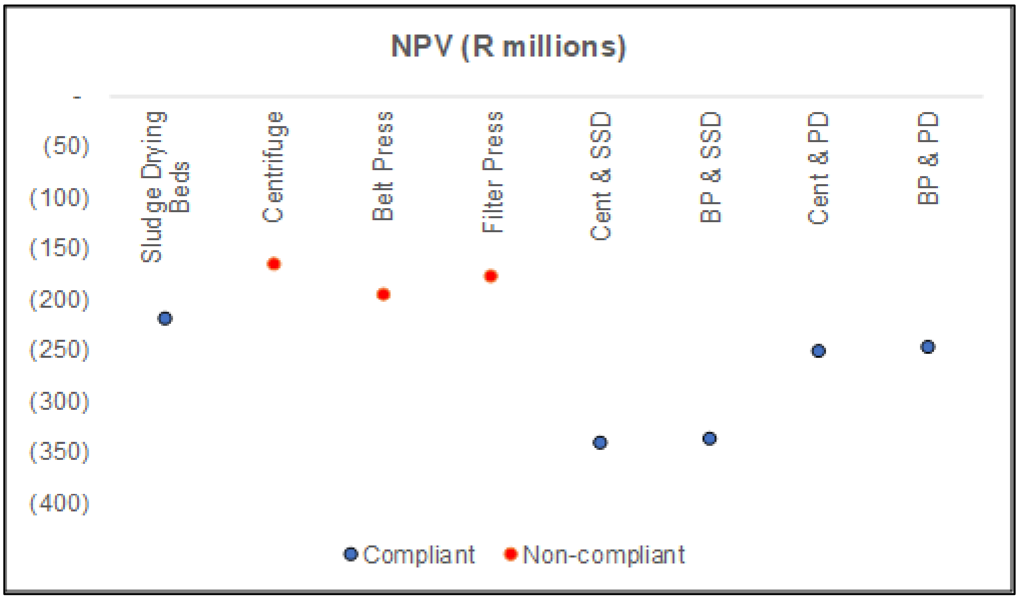


***Figure 2: Comparison of cumulative costs for dewatering and drying technologies[2]***

The diagram above highlights that the dewatering technologies provide the lowest cost over the 20-year modelled period than the drying technologies in this particular application. This can be attributed to the lower capital cost and operating costs despite having higher disposal and transportation costs. However, these options are not seen to be viable as they do not meet the minimum legislated solids content for the disposal of sludge to landfill in terms of the Waste Act. The transportation costs were based on the assumption that the landfill was 20 km away from the wastewater treatment works and a sludge disposal fee of R194/$m^3$.

The sludge drying beds are seen to be the most cost effective compliant option as the sludge quality meets the minimum requirement and the overall costs are seen to be lower than the other dewatering technologies. The diagram below provides an indication of the costs if the distance to the landfill is increased to 100km.

[2] Abbreviations are as follows: BP – Belt Press; Cent – Centrifuge; SSD – Solar Sludge Dryer; PD – Paddle Dryer

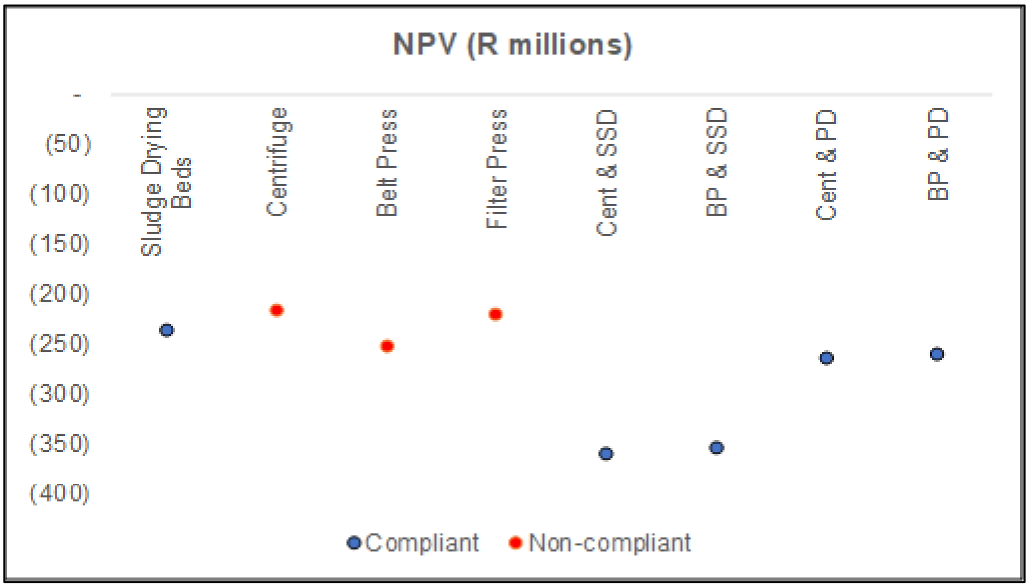


***Figure 3: Comparison of cumulative costs with an increased transportation distance***

The diagram above indicates that the sludge drying beds' option becomes more attractive if the distance to landfill increases from 20km to 100km. This is due to increased transportation costs for the higher volume of sludge produced from the dewatering technologies. It can thus be inferred that the volume and distance of the sludge being transported and the landfill disposal costs have a material impact on the sludge disposal strategies being implemented by wastewater treatment works.

## References

1. Guidelines for the Utilization and Disposal of Wastewater Sludge (Volumes 1 to 5); (DWAF, WRC – 2006)
2. Guidelines for the Utilization and Disposal of Water Treatment Residues (WRC TT 559/13)
3. GNR 634 (Waste Classification and Management Regulations (WCMR)
4. GNR 635 (National Norms and Standards for the Assessment of Waste for Landfill Disposal)
5. GNR. 636 (National Norms and Standards for Disposal of Waste to Landfill)
6. SANS 10234.
7. National Environmental Management: Waste Act, 2008