EMFULENI COMMUNITY SANITATION INITIATIVE

UTILIZATION OF WASTEWATER TREATMENT SLUDGES

Rotary Club of Vanderbijlpark

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BUSINESS PLAN STUDY 3

INVESTIGATION REPORT
September 2016

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1. INTRODUCTION

The management of Wastewater Treatment Works sludges has historically been problematic. The Sludge Management / Disposal Methods Practices in South Africa are summarized as follows (Herselman 2001):

- Stockpiling of dried sludge (40 %)
- Land disposal (20 %)
- Sludge lagoons (16 %)
- Composting (10 %)
- Farming (7 %)
- Landfill co-disposal (4 %)
- Instant lawn (3 %)
- Marine disposal (2 %)
- Pelletizing is also done in Cape Town, but has a limited effect on the total volumes of sludge.

Sludge can be a valuable resource with regard to soil conditioning, nutrients and energy. Wastewater treatment plants should be designed for zero waste which is entirely possible.

From the above it is clear that the sludges produced at wastewater treatment facilities are more of a burden than a resource. This is also true for the Emfuleni plants.

As for waste water effluent irrigation to be utilized as a resource to create jobs, relieve poverty and food security wastewater treatment sludges should be considered a resource for agriculture and power generation. Utilization of sludges are applied globally. Department of Water and Sanitation published a five volume guideline for the utilization of sludges and in particular Wastewater Treatment Plant Sludges.

2. SLUDGE VOLUMES

The sludge volumes for the three Emfuleni plants are estimated as follows:

PLANT	SLUDGE (TON) / YEAR
Leeuwkuil	7 000
Rietspruit	3 800
Sebokeng	10 000
TOTAL	**20 800**

3. SLUDGE CLASSIFICATION

The DWS classification system is as follows:

Microbial Class	A	B	C
Stability Class	1	2	3
Pollution Class	a	b	c

The **Microbial Class Classification** is indicated below:

MICROBIO-LOGICAL CLASS	UNRESTRICTED USE QUALITY		GENERAL USE QUALITY		LIMITED USE QUALITY
	A		B		C
	Target Value	Maximum permissible value	Target Value	Maximum permissible value	
Faecal coliform (CFU/g_{dry})	< 1 000 (5 log reduction)	10 000 (4 log reduction)	$< 1 \times 10^6$ (2 log reduction)	1×10^7 (1 log reduction)	$> 1 \times 10^7$ (no reduction)
Helminth ova ($Viable\ ova/g_{dry}$)	< 0.25 (or one ova/4g)	1	< 1	4	> 4

The **Stability Classification** is as follows:

STABILITY CLASS	1	2	3
	Plan/design to comply with one of the options listed below on a 90 percentile basis	Plan/design to comply with one of the options listed below on a 75 percentile basis.	No stabilisation or vector attraction reduction options required.
Vector attraction reduction options (Applicable to Stability class 1 and 2 only)			
Option 1	Reduce the mass of volatile solids by a minimum of 38 percent		
Option 2	Demonstrate vector attraction with additional anaerobic digestion in a bench-scale unit.		
Option 3	Demonstrate vector attraction reduction with additional aerobic digestion in a bench-scale unit.		
Option 4	Meet a specific oxygen uptake rate for aerobically treated sludge.		
Option 5	Use aerobic processes at a temperature greater than 40 °C (average temperature 45 °C) for 14 days or longer (eg during sludge composting).		
Option 6	Add alkaline material to raise the pH under specific conditions.		
Option 7	Reduce moisture content of sludge that do not contain unstabilised solids (from treatment processes other than primary treatment) to at least 75 percent solids.		
Option 8	Reduce moisture content of sludge with unstabilised solids to at least 90 percent solids.		
Option 9	Inject sludge beneath the soil surface within a specified time, depending on the level of pathogen treatment.		
Option 10	Incorporate sludge applied to or placed on the surface of the land within specified time periods after application to or placement on the surface of the land.		

The **Pollution Classification** is as follows:

Aqua regia **extractable metals (mg/kg)**	POLLUTANT CLASS		
	a	b	c
Arsenic (As)	<40	40 – 75	>75
Cadmium (Cd)	<40	40 – 85	>85
Chromium (Cr)	<1 200	1 200 – 3 000	>3 000
Copper (Cu)	<1 500	1 500 – 4 300	>4 300
Lead (Pb)	<300	300 – 840	>840
Mercury (Hg)	<15	15 – 55	>55
Nickel (Ni)	<420	420	>420
Zinc (Zn)	<2 800	2 800 – 7 500	>7 500
Note : A 90 % compliance is required to comply with the requirements of a pollutant class. The compliance will therefore only be evident once 10 sample results are available.			

The utilization requirements of sludge in accordance with classification are as follows:

SOUTH AFRICAN SLUDGE CLASSIFICATION		IS AGRICULTURAL USE AN OPTION?	ANY ADDITIONAL RESTRICTIONS AND REQUIREMENTS?	NOTES
Microbiological Class	**A**	Yes (i)	No	Could potentially be used as a saleable product.
	B	Qualified yes (ii)	Yes	General restrictions / requirements apply.
	C	Maybe (iii)	Yes	Only permissible if Stability class 1 or 2 is achieved. (General restrictions / requirements apply).
Stability Class	**1**	Yes (i)	No	Could potentially be used as a saleable product.
	2	Qualified yes (ii)	Yes	Additional management actions required to encourage compliance with class 1.
	3	No (v)	Not applicable	Stability class 3 may not be used in agricultural practices.
Pollutant Class	**a**	Yes (i)	No	Could potentially be used as a saleable product.
	b	Qualified yes (ii)	Yes	If the soil analysis is favourable.
	c	No (v)	Not applicable	Pollutant class c may not be used in agricultural practices.
Note :	Sludge that complies with all requirements of Class A1a may be sold or alienated to the public for unrestricted use.			

It is the intention to produce A1a sludges that can be applied without any restrictions through the treatment processes indicated under 4 below.

4. SLUDGE TREATMENT

The Rietspruit Wastewater Treatment Works sludge is placed in sludge lagoons with the supernatant water returned to the plant. The accumulated sludge is fully stabilized and will be extracted and composted as part of the Pilot Project. This will meet the microbial and stabilization criteria. The heavy metal content of the waste water is low as measured by Rand Water and the sludge will comply with the pollution criteria. The above should produce A1a sludge with no restriction application. Lower classification sludge may be considered depending on the produce selected.

The sludge produced at Sebokeng WWTW from the facilities utilized for the irrigation project will be activated sludge waste (MLSS) and will be pumped to the farm area and stabilized in anaerobic sludge dams. The supernatant that will be rich in phosphates and nitrates (NH_3) will be directed to the effluent stream for irrigation. Once stabilised the sludge will be treated as for Rietspruit and applied to land.

The sludge produced at Leeuwkuil will be dried on site and transported to the farming areas for composting and land application.

5. APPLICATION OF SLUDGE

The primary goal will be to produce A1a sludges that can be applied without restrictions to all crops. It is also anticipated that B1a or B2a sludges be produced for application at qualifying crops.

The average application rate/m^2 will be ± 1,0 kg/year. The WWTW processes providing effluent water for irrigation will not remove nutrients and the sludges will have correspondingly lower nutrient contents.

The main purpose of the sludges will be conditioning of the soils with regard to organic content and the retainment of water for crops.

The application of the sludges will reduce the water demand for agricultural activities which is in line with the optimum water utilization goals.

6. SLUDGE TO ENERGY

The anaerobic digestion of the sludges for methane production and power generation can be considered. At this stage, however, the utilization of the sludges for land application is considered priority due to the need for soil conditioning, lower required technology and higher labour requirements.

7. CONCLUSION

The sludges generated by the three WWTW in Emfuleni are a resource that should be recognised as such and utilized.

High quality sludges can be produced that can be applied with no or very limited restrictions on crops under the anticipated scheme to utilize waste water for agricultural irrigation.