Chapter 8

Concluding Remarks

8.1 Introduction

As sewage sludge comprises high levels of organic matter and nutrients such as N and P, it can be used as soil conditioner, particularly in developing countries. In South Africa one of the serious problems is the widespread degradation of agricultural soil due to erosion and nutrient depletion.

Unfortunately, utilization of sewage sludge for agricultural purposes has disadvantages as well. Apart from aesthetic reasons, the principal disadvantage of the agricultural use of wastewater sludge is the potential of the transmission of human bacterial and parasitic infections through consumption of produce, if the sludge used was not adequately treated (Rudolfs *et al*., 1950).

While benefits that result from using sludge as soil conditioner have been studied widely, knowledge on its limitations regarding microbial pathogens is limited. This study sought to establish the potential prevalence of pathogenic microorganisms in a high risk crop grown from soil amended with sewage sludge, and to provide suggestions on management practice for beneficial use of sludge.

8.2 Research Findings

The two types of sludge, namely low metal (LMS) and high metal sludge (HMS) were found to have several human pathogenic microorganisms, including the *E.coli* and *Salmonella* spp (Chapter 3). This is consistent with other studies on sludge pertaining to the types of microbes present in sludge (Strauch, 1991; Juang and Morgan 2001).

These organisms persisted in soil for a period of three months during planting (Chapter 4). Earlier, other researchers (Strauch, 1991; Baloda *et al*., 2001) reported on the survival of *E.coli* and *Salmonella* spp. Culture based technique showed the prevalence of these microorganisms on the potatoes grown in 16 tons/ha LMS. None of the potatoes from other treatment options (LMS 8 tons/ha, HMS 8 tons/ha and HMS 16 tons/ha) had any of these organisms (Chapter 4).

Further analysis of contaminated potatoes using molecular technique yielded no viable primary pathogenic organisms (Chapter 5). Although some species of the *Enterobacteriaceae* were found to be present in the potato, none of these were indicated as primary pathogens to humans. None of the 16S rRNA sequences from potatoes matched any of the *Salmonella* spp or *E.coli* from the data bank. However, *E.coli* and other enteric pathogens, namely, *Proteus sp, Enterobacter sp* and several *Klebsiella* spp were isolated from the sewage sludge-contaminated soil in which these potatoes were grown. Organisms isolated from the crops were mainly plant organisms that are known to be responsible for diseases such as rotting in potatoes.

Observations from this study suggest that if a single application of sludge is made during planting, and crops remain in the field for a period no less than three months, it is possible that pathogen load will be significantly reduced (Chapter 4). However, proper sludge treatment and management prior to use is essential. These management practices require taking into consideration the unique prevailing conditions that affect agriculture in South Africa (Chapter 7).

8.3 Sewage Sludge Management Requirements

This study has shown that while pathogens are present in sewage sludge, this can be managed to maximize on the benefits associated with land application of sewage sludge can be realized. The underlying basic requirements are proposed

to assist sludge producers, regulators and handlers with regard to sewage sludge management:

8.3.1 Developing the awareness, understanding and commitment of the community

If community groups and farmers are not completely convinced of the benefit of land application of sewage sludge, the utilization system will not be successful. The communication strategy should be open and transparent. In a country such as South Africa with different cultural backgrounds and languages, communication can be achieved by providing brochures and seminars in languages spoken by predominant groups such as isiZulu, Afrikaans, seSotho, isiXhosa and English. Citizen commitment can also be enhanced by site visits and encouragement of community participation in advisory forums.

Farmers, constitute a group that will easily appreciate using sewage sludge in fertilizing agricultural soil (Snyman and Van der Waals, 2003), but they still need to comprehend the importance of adhering to code of practice regarding sludge application.

8.3.2 Recruitment and training of competent people

Training of competent people to operate and manage the system will ensure effective management.

8.3.3 Securing long-term support of politicians

In a country of widespread political diversity as is the case in South Africa, it is necessary to reach all spheres of political interest, such that once the system is in place it will remain sustainable irrespective of changes in the political interest

of the ruling body. Political support can be gained through educating politicians regarding the needs and benefits of the country's people.

8.3.4 Foster knowledge and understanding by way of capacity building

By reaching the educational infrastructure, through awareness in undergraduate and postgraduate programmes in the fields of science and engineering focusing on specialized training in sewage sludge management. This will ensure that there is always an available pool of individuals who appreciate the benefits of sewage sludge utilization, who will eventually contribute to effective management of the system.

8.3.5 Monitoring systems necessary to compliance

The quality of sewage sludge to be used for land application must be closely monitored to ensure acceptable quality and to determine appropriate application rates. Parameters of concern, both biological and chemical need to be regularly checked to protect both human health and the environment.

8.4 Future Trends

Utilisation in agricultural land will continue to grow as the preferred sewage sludge management practice because it is based on the fundamental concept of sustainable waste management. Societies worldwide are recognizing that there is an urgent need to change our thinking from resource consumption to ecosystem protection, and from disposal of what is regarded as waste materials to the extraction and reuse of the valuable portion of these resources.

The need for effective sewage sludge management systems in developing countries is particularly urgent. In order to accelerate their process of formulating management systems, some developing countries have adapted the experiences

of existing systems to meet their local needs. For instance, Mexico adopted the US limits for heavy metals and Faecal coliforms and modified the limits for *Salmonella* spp and the *Ascaris* ova (Jimenez *et al*., 2003). Coupled to the necessary management systems, is changing the perceptions of environmental groups and improving the knowledge of the general public regarding sludge use.

8.5 References

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