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Management of Coal Ash Residues: The Role of Health Sciences

Landfill disposal of waste in South Africa is governed under guidance documents entitled *Minimum Requirements for the Handling, Classification and Disposal of Hazardous Waste* (Second Edition 1998, First Edition 1994) of the Department of Water Affairs and Forestry ("Minimum Requirements").

Similar to many guidance documents that are more than 20 years old, the approach is burdened with questionable scientific constraints and inflexibility, assuming worst-case scenarios, conservative assumptions, and stringent, sometimes unrealistic disposal requirements. The greatest limitation is that international developments in health and environmental sciences and application of these disciplines in waste disposal practices have not been taken into consideration. The Minimum Requirements approach is inadequate and inappropriate in comparison with current international practice.

Worldwide there is great emphasis on cost-benefit analysis in the assessment of environmental options in waste management and there is an increasing need for innovative, practical and cost-effective approaches. With health sciences as key competence towards achieving these objectives, leading agencies in the world conduct site-specific risk-based assessments to evaluate safe options for landfill disposal of waste. A tiered approach is followed, in which the level of risk assessment spans from a qualitative or screening assessment in the first tier to a full-scale quantitative risk assessment in the third tier. As the assessment progresses through tier-2 to tier-3, understanding of the factors that affect contaminant leaching and migration becomes more and more important. The assessment may stop at any stage where adequate information is available to take a decision that would be safe and cost effective. The final interpretation of a site-specific risk assessment relies heavily on competence in health sciences.

An integrated framework for the assessment of leaching of coal combustion residues (CCRs) and for screening evaluation of beneficial use and disposal options of a range of CCRs has been developed by an international team of scientists.

Release of hazardous constituents from a waste body into underlying groundwater is controlled primarily by two factors, namely containment and attenuation.

The aim of containment is to minimise the volume of leachate that can reach groundwater by restricting migration from the waste body through installation of a liner system.

Attenuation of contaminants in leachate is effected by the natural subsurface processes of filtration, sorption and ion exchange that limit migration of contaminants. This is governed by site-specific geochemistry and hydrogeology attributes.

In concert with the consideration of containment and attenuation, site-specific contaminant transport and fate modelling in groundwater is needed to complete the assessment of potential health risks that may be associated with CCR leach test results.

A quantitative multi-component health risk assessment that encompasses the elements outlined above cannot be conducted with confidence if a high level of understanding of health sciences is absent.