Magalies River, 2003 – different stages of algae blooms

Biomass *removal and management*

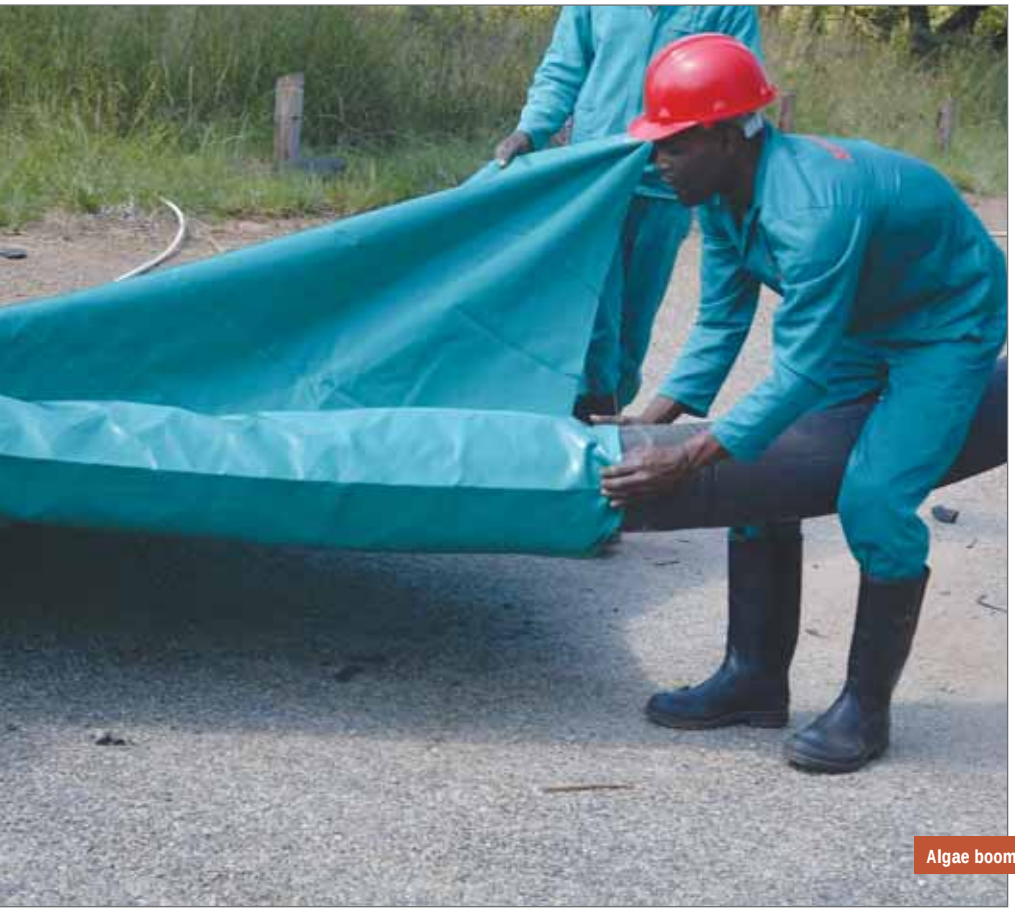
INTRODUCTION

The effect of eutrophication in the Hartbeespoort Dam manifests itself through vast and excessive algae blooms, as well as prolific growth of water hyacinths in all areas of the dam, although concentrations occur along the shoreline and in funnelled areas because of wind action. Furthermore, the seeds of the hyacinths also germinate from mid-July along the shallow areas. Calculated from the total incoming (external PO_4 load >420 tons/annum) and available nutrients from the dam (internal PO_4 load >2 000 tons), the growth potential of the photosynthesising biomass is much more than the estimated 10 000 to 20 000 tons of biomass which are produced over one year from the 2 000 hectare full-level surface area of the dam that is exposed to the sun. Variably the *Microcyst*is blue-green algae and the exotic hyacinths (category 1 aquatic weed) make up most of the biomass. Biomass is managed by harvesting and removing both algae and hyacinths from the surface of the dam. This does not only curb the immediate growth, but also removes nutrients already trapped in the biomass. This approach results in an immediate improvement of the visible and noxious conditions in the dam.

ALGAE

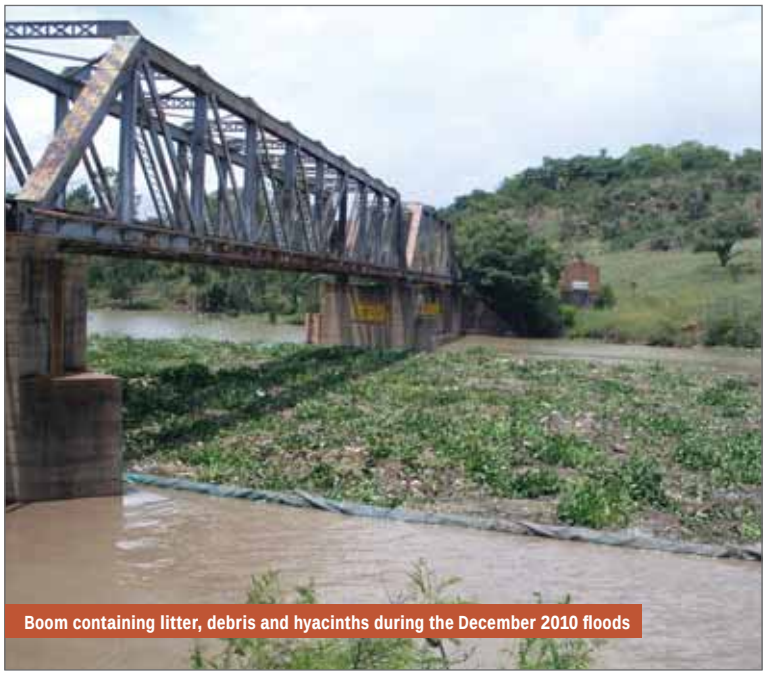
The algae mass is not only unsightly, but decaying material tends to emit a foul odour, over and above producing potent hepato-toxins (microcystine). Although the algae grows over the entire surface area of the dam, through wind action it is concentrated along the northern shoreline during summer months, and in the direction of the more dominant southerly wind during late autumn before the first temperature inversions in the dam start.

The biggest concentration point is at the dam wall, from where the concentrated algae clouds are removed with



Algae boom refurbishment

A mass of hyacinths at the dam wall



Boom containing litter, debris and hyacinths during the December 2010 floods

the aid of floating pump stations. About 2 000 m of constructed floating curtains (booms) are employed at three points on the dam to control the movement of algae, and facilitate concentration and funnelling to the removal points, thereby also alleviating hazardous conditions for recreational users. This removal reduces the sensory impact of the algae mass during times of high concentration, as well as the quantity of algae in the dam, which helps to reduce the exponential growth rate associated with the algae.

HYACINTHS

Hyacinths have a higher nuisance value in terms of their coverage of the water surface and the limitations their growth places on recreational activities on the dam. The invasive water plant can generally be found on the surface of the dam, and a vast quantity is transported into the dam from the rivers feeding the dam. Similar to the algae, the hyacinths, together with organic and inorganic debris, also tend to concentrate at the shore and the dam wall areas. Hyacinths are removed mainly by hand, and with great success at the 30 m high radial sluices, and from all around the dam, but particularly from areas that are easily accessible from the shore.

Debris is also a nuisance as it is not only unsightly, but has a detrimental

Algae pumping at the dam wall

Hyacinths in a sluice gate (for removal)

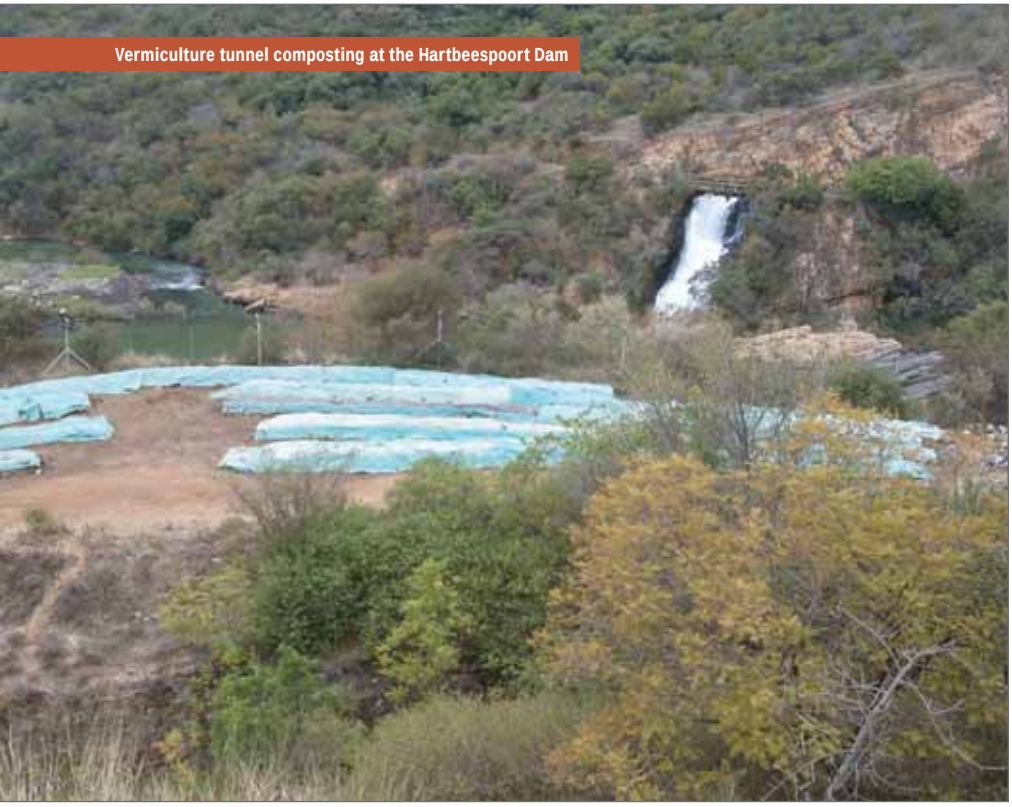
Removal of hyacinths from a 30 m sluice gate at the dam wall

impact on the greater environment, often affecting bird- and other wildlife, as well as posing a danger to recreational users of the dam. Debris containment curtains are constructed at the Crocodile River inlet to the dam, and during periods of normal rainfall most of the debris is trapped and successfully removed.

To date the programme has removed in excess of 44 280 m^3 of hyacinths, at least 1 625 m^3 of litter and debris, and pumped 16 million litres of algae soup. The amount of hyacinths, litter and debris prevalent in the dam is highly dependent on environmental conditions, such as rain or flooding. During 2008/9 the programme managed to remove virtually all the hyacinth from the dam during the winter months.

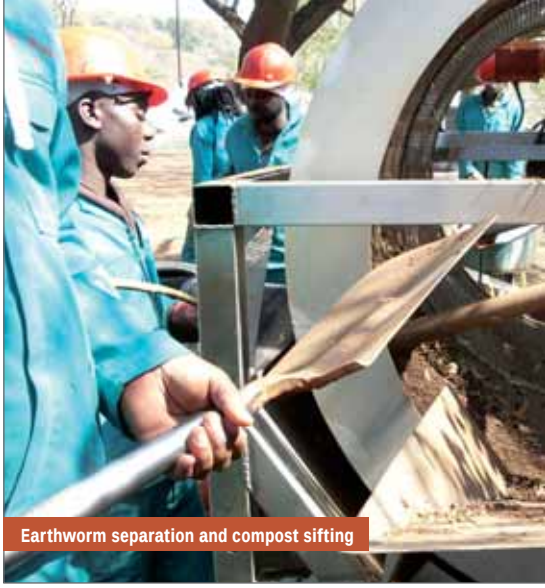
However, the high rainfall experienced in the area during the summers of 2009/10 and 2010/11 meant that the dam level remained at full capacity throughout the winter of 2011. This high water level resulted in previously exposed winter shorelines remaining underwater, and therefore a significant amount of hyacinth could not be removed. In addition, the wind and rain often hampered cleaning-up efforts. These factors have now resulted in a vast amount of hyacinth already being present in the dam at the start of the August/September 2012 growth season.

Removing hyacinth around the dam



Vermiculture tunnel composting at the Hartbeespoort Dam

Vermiculture intensive units



Earthworm separation and compost sifting

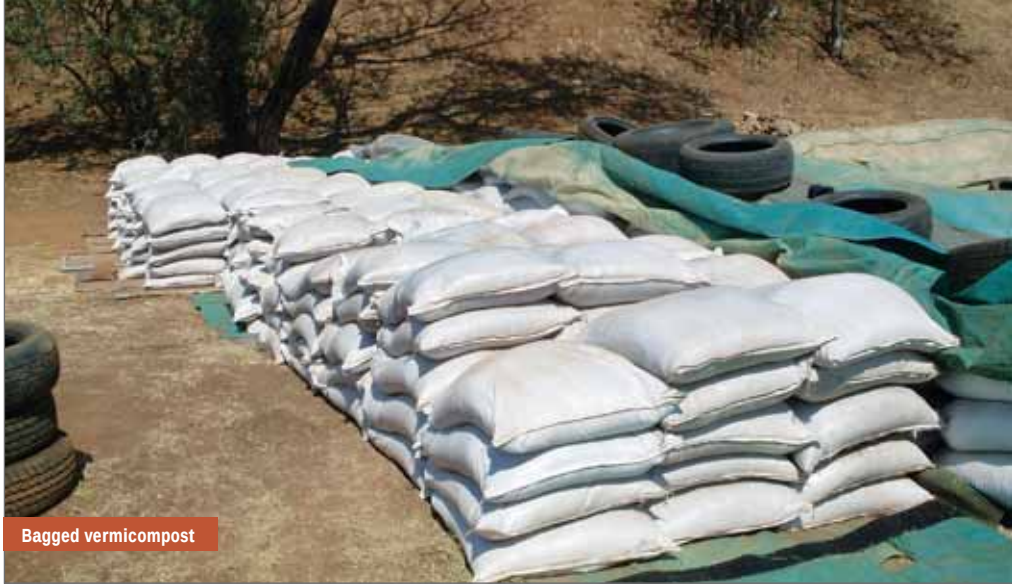
VERMICULTURE

In order to effectively deal with the algae, hyacinths, litter and debris, the Hartbeespoort Dam Integrated Biological Remediation Programme (HDRP) has put waste recycling and reuse principles in place whereby organic matter is composted through a process known as vermiculture (earthworms). This method is simple, effective, convenient, noiseless; saves water, energy and landfills; and helps to recondition degraded land. It is a value-added process where the end products are sought after compost and protein. Earthworms, or nature's friendly little helpers, have the ability to convert organic waste into nutrient-rich organic material, which also increases water retention and soil moisture content when applied to soil. In this programme the vermicompost is used for shoreline remediation, and in the construction of floating wetlands. Worm husbandry produces premium soil and liquid products, as well as protein.

The most common method of solid waste disposal remains land spreading, which results in polluted soil and surface/groundwater. Vermiculture ensures that none of this pollution occurs. Applying vermicompost to aquaculture ponds reduces the input cost and ensures that no harmful chemicals are introduced into the system. Vermiculture technology is suited to urban and rural communities and is a sustainable way of dealing with waste.

The earthworm species *Eisenia Foetida* is most commonly used for composting of high organic content, but in the HDRP indigenous African crawler species are also used in combination (*Eudrilus Eugeniae; Eisenia Hortensis*).

The use of earthworms in the biomass composting process is an integral part in reducing the total biomass, and in turn physically reduces the sensory impact



Bagged vermicompost

of eutrophication. Hyacinths have been a problem on the Hartbeespoort Dam since the mid-1970s, and by the late 70s about 80% of the dam was covered by the invasive plant. The Department of Water Affairs then decided to eradicate the hyacinths through chemical spraying, which continued until the HDRP placed a moratorium on the chemical treatment of hyacinths in 2007. Regrettably, the chemical spraying and the rapid development around the dam since the 1990s have contributed to the destruction of up to 40 km of natural vegetation on the shoreline around the dam.

Through the dam remediation programme a nucleus has been established at the Hartbeespoort Dam wall, also housing the vermiculture hub, which serves as a base for training, capacity building and a skills and knowledge transfer centre for earthworm breeding. In addition to the valuable organic fertiliser produced in the process, the earthworm protein can be used as food for chickens and fish.

The potential to produce protein from organic 'waste' (like garden refuse), is encouraging and a valuable option for meeting the protein shortage in developing countries. This is a long-term objective for the future development of aquaculture and protein production through vermiculure in parallel for the region.

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Source:
http://www.saice.org.za/downloads/monthly_publications/2012/2012-Civil-Engineering-August/#/0