AUSTRALIAN ORGANIC RESOURCES (AOR)

The Heller Process

TRANSFORMING BIOSOLID WASTE INTO HIGH YIELD FERTILISER

The Heller Process treats contaminated biosolids, converting them into a valuable organic fertiliser product that can be applied unrestricted in all agricultural settings.

The Problem

Biosolids are the solid waste produced as a by-product of sewage treatment. Currently 360,000 tonnes are produced annually in Australia and New Zealand. The use of biosolids as fertiliser is the most sustainable means of dealing with this waste matetrial. However, biosolids contain significant levels of toxic heavy metals, which can be potentially harmful to the environment if applied to land in large quantities. Agencies, such as EPA, have set limits for the heavy metal content of biosolids that can be used for land application. Australian Organic Resources (AOR) has developed an acid extraction process that reduces heavy metal concentrations and destroys pathogenic bacteria in biosolids waste materials to the point where the resulting organic fertilizer can be applied to land without restriction.

AOR

The Process

The Heller Process is an acid-based chemical process that decontaminates biosolids and soils, including the removal of heavy metals and the destruction of pathogenic bacteria. It is effective in addressing the three key issues for Biosolids management, stabilisation, pathogen reduction and de-watering. Moreover, the Heller process specifically addresses the key issues, namely odour management, removal of pathogens and extraction of heavy metals. The process can be applied to any solid matrix that requires decontamination of heavy metals.

The Chemistry

The acid extraction used in the Heller process utilises a combination of acids. The proportion of each acid added in the process has been optimised after several years of extensive laboratory-based trials at two Leading Australian Universities (The University of Melbourne and La Trobe University). In addition to the acids, cation exchange enhancers are also added during the process. The exchange enhancers act to further reduce the levels of metals in the waste material, and in over 90% of cases, the concentration of heavy metals remaining in the waste solid conform to EPA Victoria guidelines as C1 T1 categorised material for unrestricted use. After dewatering the acidic material is neutralised to bring the pH of the final product up to around 7. The neutralisation process also dilutes remaining metals, hence the final commercial product contains contaminants at concentrations well below the strictest of EPA guidelines.

Other benefits

The efficient removal of heavy metal contamination is not the only application or benefit of the Heller process. In addition to metal removal, the process destroys all pathogenic bacteria, and eliminates odour. The oxidising conditions produced in the process also mean that many toxic organic species (such as herbicides and pesticides) will also be destroyed.

The process does not affect the nutrient quality of the organic material—nitrogen and phosphorous levels are not reduced. In fact, nitrate levels are higher post treatment because of the application of nitric acid. Other macro-nutrients, such as calcium, are also preserved, and even increased after the neutralisation process.

The product

The product is a soil medium which;

- is free of excessive heavy metal, pathogens/ and other impurities,
- is rich in minerals and macronutrients,
- has a neutral or slightly alkaline pH, and capable with lime additives to be tailored to suit or modify soil pH levels,
- is friable and light in texture,
- is of an open texture to allow free draining of water and aeration,
- is able to provide a growing medium without the requirement to add fiber or coarse aggregate.

These qualities make it an ideal product for the complete range of agricultural and horticultural uses, including crop and amenity horticultural requirements. Its texture enables it to be mixed with other mediums, and to be applied by conventional spreading machinery.

Product uses

This product has the capability of providing a growing medium of sufficient strength in terms of its qualities to replace a range of horticultural practices presently undertaken by growers and amenity horticulturalists. Tasks presently undertaken to modify soil texture, structure and chemical content are generally undertaken as individual tasks. The attributes of the 'Heller' biosolids allow many of these tasks to be completed in one application.

The product is therefore able to provide a complete growing medium and soil modifier as a one-action program rather than a number of actions as are often undertaken. It simplifies soil management for both the professional and amateur plant growers. It is therefore a unique product that not only improves soil profiles, but also eliminates a major environmental waste product.

The product is flexible in the sense that its texture enables it to be adapted for a wide range of uses, from fine surface applications such as top dressing of sports fields, to use as a complete potting medium, or as a mixture with other growing mediums.

Processing

An overview of the treatment and decontamination processes is provided below:

Extraction tanks are loaded with a chemical solution. This phase may contain wetting, complexing and/or deodorising components if required.

A pre-determined amount of sludge is added to the vessels and kept in suspension by mechanical stirring. (Loading of the system may occure simultaneously with filling of the extract solution).

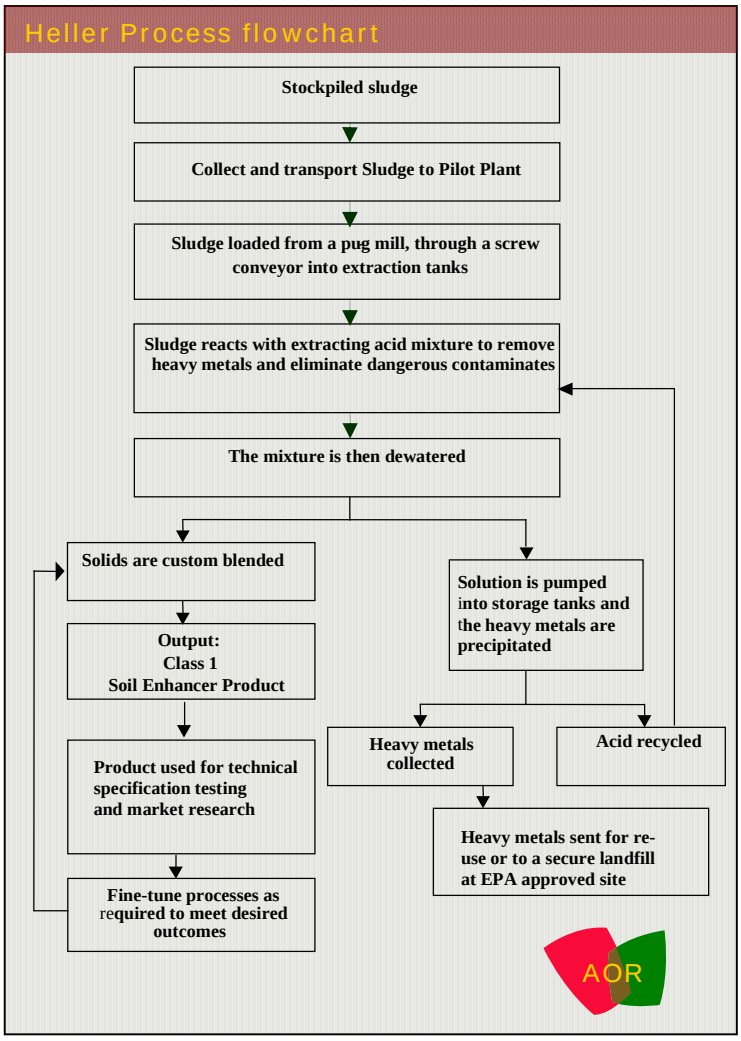
Heavy metals are rapidly extracted into the liquid phase, for about 30 to 60 minutes. On completion of the extraction, the mixture is passed through a suitable decanter.

This process provides two streams

i) A solid stream, which is processed once more to remove the remaining metals. After two processing operations, sufficient contaminants are removed to comply with the current Environmental Protection Authority of Victoria draft guidelines. De-contaminated sludges are blended. Further nutrients, minerals and structuring agents may be added at this stage to produce a customised product

ii)The second liquid stream, which is loaded with heavy metals, is transferred to a heavy metal removal tank. Metals will be separated in the form of a flocculent precipitate which is removed from the liquid by the de-watering apparatus. The metals will be sent to a smelter for recycling. The clarified liquids are recycled to the system where they are dosed with chemicals and other additives to be used again to treat incoming sludge. Alternatively the clarified liquids can also be released for irrigation and be replaced with contaminated or grey water.

Precise details of the processing procedures and techniques are subject to patent. In general plants will be designed in relation to the amounts of product to be treated, and a mobile plant can be constructed to treat smaller quantities of material on different sites.



Process waste

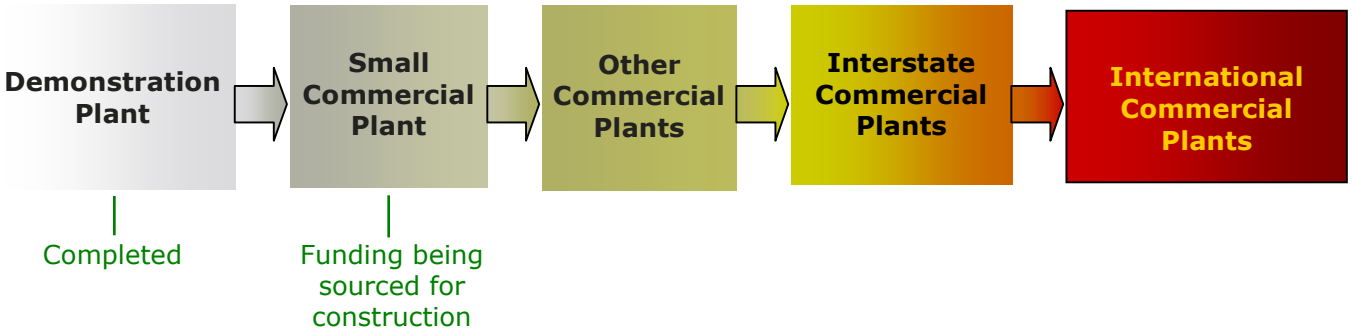
The only waste stream is that containing removed metals. The metals are collected and it is proposed to have this material smelted commercially. After heavy metal separation, liquid is returned to the process as shown in the flowchart. The liquid will contain some salts and nutrients that are beneficial to the product. A patent covers this part of the operation that allows the liquid volume to be kept low, reducing processing time and eliminating a liquid waste stream.

The Plan

The focus of AOR is to provide a sustainable solution for contaminated biosolids and other soils. The company started with a feasibility study and a business plan. AOR intends to form a partnership with a company that is environmentally orientated, has the vision and infrastructure to commercialise the internationally patented technology. AOR wants to export the technology and licence it to suitable operators.

The proposed Business Model firstly requires development of a demonstartion plant, and then a commercial plant at a location to be determined. Thereafter additional smaller plants in Victoria and larger interstate operations will be considered. The commercial growth strategy then envisages international licensed operations providing a royalty income to AOR.

This growth strategy is dependent on compliance with specific environmental requirements and on achieving satisfactory return on investment criteria, including acceptable entry price points for commercial soil enhancer products.
The Business Model and Rollout Strategy is summarised in the Figure below.



The Department of Sustainability and Environment has indicated to AOR that Government contribution for the commercialisation could be available on a dollar for dollar basis.

FAQ

Q. What is the effect of the extracting acid on the organic matter?

A. Some of the very soluble fraction of the organic phase leaches during the process but this fraction is very small. The organic material is less soluble at very low pH. Some organic functional groups will be hydrolysed during the acid leaching, but this does not affect the nutrient value of the biosolids.

Q. How does this process affect pesticide residues, as per Biosolids Guidelines?

A. The leaching treatment used in this process is primarily aimed at removing metal cations. Organic residues will not be removed to the same extent as metals. Organic bases (many organic herbicides and pesticides are bases), however, will become cationic under the acid treatment conditions and hence will be removed to some extent. In addition, because highly acidic conditions favour hydrolysis, many low molecular weight compounds (such as pesticides which break down by hydrolysis in the natural environment) will be quickly degraded under the leaching conditions.

Q. Do you have prior and post treatment data regarding pathogens, metals, pesticides, macro elements (nutrients) and organic matter?

A. Heavy metal concentrations are generally reduced to below EPA C1 T1 guidelines. Amounts of organic and inorganic P and N remain roughly constant (in fact nitrate increases when nitric acid is used in the extraction process). Other macro nutrients such as Ca are added back in as well.

Q. Does the process contain an acid-wash phase for re-using the acid, and if so, are the metals precipitated out? How much acid is required to treat the biosolids?

The metals are precipitated from the liquid; some acid is used 2 to 3 times; the economics of the process do not require full acid recovery. The specific amount of acid and agents required is determined by the contamination level of the product to be treated.

Q. Is your process also suitable for other waste streams?

A. The process can handle most sludge waste streams and soils.

Q. What is the pH of the treated biosolid?

A. The pH can be adjusted to requirements during the neutralisation process; generally the pH is between 6 and 7.