PLATE 3
COMPOSTING:
In-Vessel

1. Suitable for the following sludge types:
- untreated primary
- lagoon stabilised
- anaerobically digested
- aerobically digested
- ATAD
- dual digested

2. Sludge Dewatering requirements:
- minimum 15% dry solids content
- maximum 40% dry solids content

3. Stabilisation requirements:
- none required but composting untreated primary sludge has an odour potential
- anaerobic or aerobic stabilisation preferred
- aerobic stabilisation for WAS from CAS or BNR (not a typical composting application)
- Air with at least 50% of oxygen remaining should reach all parts of the composting materia

4. Process description

4.1 Composting in General

Composting is the biological decomposition of organic material to produce a stable end product suitable as a soil conditioner.

Principal factors for successful composting other than adequate aeration and sufficient quantities of amendments and bulking material are:

Parameter	Value
Moisture content	40% - 60% (w/w)
Temperature for stabilisation	55°C - 60°C
Sludge pH	6 - 9
C/N ratio (w/w)	20 - 35:1 (w/w)
Composting period	8 - 18 weeks *
*Depending on which composting method is used	

During composting there are three separate stages of activity and associated temperatures observed. They are mesophilic, thermophilic and cooling stages. In the initial mesophilic stage the compost pile temperature rises to about 40 °C with the appearance of fungi and acid-producing bacteria. As the temperature rises to about 70 °C (thermophilic stage) these organisms are replaced by actinomycetes and thermophilic fungi. The maximum degradation and stabilisation of organic material occurs at this temperature range. During the cooling or curing period further water release takes place as well as pH stabilisation and completion of humic acid formation while there is a general decrease in micro-organism activity.

The water content of the sludge used for composting effects the wet weight of the mixture and therefore the amount of bulking material that is required. The wetter the biosolids being composted, the more amendments and/or bulking agent would be required. Common amendments are sawdust, grass clippings, chipped green waste and rice hulls. A widely used bulking agent is chipped wood waste. After final screening the oversized material is returned to the initial mixing step.

Area requirements would include sufficient area for the bulking and amendments materials, mixing and screening process, main composting process and storage of the final product.

4.2 In-Vessel Composting Process

Composting takes place inside an enclosed vessel or reactor. Process parameters like moisture, air flow, temperature, and oxygen concentration can be closely controlled and odour release minimised. This results in a shorter composting period. There are two major categories of in-vessel composting ie plug flow and dynamic. The plug flow process operates on a first-in first-out principle while the compost material is continuously mixed in the in the dynamic system.

With in-vessel composting the product quality is more consistent in relation to pathogen reduction, while it has smaller area requirements than windrows or aerated static piles.

5. Biosolids Classification **(EPA Victoria Draft (2002) Guidelines for Environmental Management)**

The biosolids classification is dependent on the process conditions, ie temperature and composting period. Windrow processes may have difficulties consistently achieving T1 grade, while aerated processes are likely to be more reliable.

Method Class	Class	EPA Victoria Draft (2002) Requirements
Windrows Digested sludge	T1	55°C for 15 days + 30 day storage
Windrows	T2	≥53°C for 5 days or ≥ 55°C for 3 days; volatile solids reduction ≥ 38%
Windrow	T3	5 days > 40°C and 4 hours >55°C

6. Market for final product

Compost market. The application will depend on its classification

7. Benefits
- high degree of process control
- small area required
- very good temperature and odour control
- short composting period
- high quality product

8. Limitations
- high capital cost
- high O&M cost
- applicable to large scale operations only (>60 t/d that is >20 000 t/year)
- no In-vessel composting facilities in Australia

9. Costs (In-vessel Composting)

Typical capital and O&M costs are not available due to the lack of references in Australia. Costs are expected to be site specific.

Indicative costs for in-vessel composting activities in the Netherlands for a 25 000 tonne per year capacity show that $16-$20 M is required in capital while operating costs are typically between $110 and $140 per ton.

10. Product sale

The price of the compost produced is estimated at approximately $30/m^3. The sale of the compost can be used to off set part of the processing cost for the sludge.