PLATE 11
HEAT DRYING

1. Suitable for the following sludge types:
- untreated primary
- lagoon stabilised
- anaerobically digested
- aerobically digested
- ATAD
- dual digested
- WAS from CAS or BNR (WAS is not typically suitable)

2. Dewatering requirements:
- minimum 15% dry solids content
- higher dry solids content is preferred

3. Stabilisation requirements:
- none required
- anaerobic or aerobic stabilisation preferred

4. Process description
The purpose of heat drying of sludge is to reduce the water content from the wet sludge so that it can be processed into a granular final product. It is accomplished by vaporisation of water to the air by using an external energy source

The principal product with all heat drying processes is granules or pellets with moisture content less than 10% (w/w). This pelletised product is not unlike traditional artificial fertiliser in size and appearance and is used as a valuable commercial soil conditioner. Its nutrient value is dependant on the input sludge quality. Whilst being subjected to a pasteurisation process which destroys pathogens, sufficient microbes remain in the product to assist decomposition in the soil.

A number of mechanical drier types are available each with its own unique features. A rotary drum type drier is discussed as an example.

A large burner heats up gas (from the sludge) and air to a temperature of about 450°C which passes through a heat exchanger to heat the drying drum. Dewatered sludge is usually mixed with under and oversized pellet product prior to introducing it into the drying drum. In the drum the sludge mixture tumbles around in the hot gases until the water in the material evaporates. The hot gases are separated from the mixture and granules are produced. The air containing odours generated by the process is returned to the combustion chamber and burnt off. Dust is extracted from the air and used again. After leaving the drum the dry granules are separated into grades, cooled and bagged, ready for use.

Heat for drying is usually provided by combustion of natural gas, LPG or biogas if it is available. Apart from the capital cost of drying equipment, the main cost associated with heat drying of sludge is the cost of the energy required. For this reason it is easier to justify the expense of sludge drying at plants with existing anaerobic digesters, as the quantity of biogas is often enough to generate heat needed for heating both digesters and drier (by recovery of heat from the drier.

5. Biosolids Classification **(EPA Victoria Draft (2002) Guidelines for Environmental Management)**
The biosolids classification is dependent on the temperature achieved in the process and the dry solids content of the final product:

Method	Class	EPA Victoria Draft (2002) Requirement
Heat Drying Digested sludge	T1	$\geq 80^0$C and dry solids content>90%
Heat Drying untreated sludge	T2	$\geq$ 70 for 1 hour and dry solids content > 75%

6. Market for final product
Pelletised fertiliser market - not established yet. Application depends on classification.

7. Benefits
- dramatic reduction in sludge volume
- valuable marketable product
- containment of odours and dust
- compact process requiring small footprint

8. Limitations
- high capital cost
- high O&M cost
- no established market for product
- while modular designs are available to accommodate smaller operations, this technology is better suited to large scale operations

9. Costs (Heat Drying)
Typical capital costs and/or operating costs are not available and are expected to be site specific.

The following indicative cost example may be useful: The estimated capital cost for a biosolids handling capacity of 5.5 tonne/day is approximately $2 to $4 million. For a plant of this capacity the O&M cost is estimated at around $200 000 to 400 000.

10. Product sale
The price of the biosolids produced is difficult to estimate at this stage because it is not produced and sold in Victoria. Based on the chemical characteristics of the product, it is likely to be higher than compost because it has a higher solid content. Hence, the price is likely to be between $30 - $50/$m^3$. The sale of the biosolids can be used to off set part of the processing cost for the sludge.