CHAPTER 6

CEMENT INDUSTRY

6.1 Waste can be used as a supplementary fuel in cement kilns, as fillers in cement, and cement can be used to solidify or stabilise wastes.[1] The extent to which these mechanisms for waste treatment are used depends on the availability and proximity of the waste to cement kilns.[2] The advantage of this approach is that there are no waste products from cement kilns other than a small amount of bypass dust, which can be sold as a fertiliser.[3]

Advantages of Cement Kilns

6.2 The advantages of using cement kilns for disposal include:

- high combustion temperatures (>1500°C), long residence times (6-10 seconds) and intense turbulence inside the cement kiln, which ensures the destruction of dioxins, PCBs etc;
- the large size and heat capacity of the kiln ensure that in an emergency shutdown all waste present is completely combusted and intractable components destroyed;
- the environment inside the cement kiln is naturally alkaline, neutralising acid gases formed during the combustion process;
- modern cement plants are fitted with de-dusting facilities, such as baghouses, providing stringent pollution control;

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[1] Ryan, Evidence, p.777; see also Griffith University (1992) *Kilnburn '92 An International Conference on the Role of Cement Kilns in Waste Management*, 10-11 September 1992, Brisbane.

[2] Ryan, Evidence, p.777.

[3] Benkendorff, Evidence, p.432.

- most of the ash resulting from the incombustible material in the waste, such as metal, is incorporated in the product, reducing requirements to landfill;

- more highly efficient energy recovery (100 per cent) is obtained from the combustion of the waste as a replacement fuel in a cement kiln than in a waste to energy facility (about 30 per cent);

- energy costs generally account for 40-60 per cent of cement production costs, and use of waste as supplementary fuel could reduce dependence on fossil fuels;

- only a small capital investment of $5-10 million is required to adapt a cement kiln for combustion of waste - this is much less than the cost of a new EFW facility; and

- cement kilns are also capable of dealing with a wide range of intractable industrial wastes, including paints, thinners, waste oil, tyres and sewage sludge.[4]

Supplementary Fuels

6.3 Energy costs in Australia are much lower than in Europe or Japan and therefore the use of waste as fuel has been much lower here.[5] However, with the increased import of cement products, there may now be sufficient economic incentive for the increased use of supplementary fuels in cement kilns.[6]

6.4 The use of waste as supplementary fuels in the firing process includes the use of solvents, contaminated wood waste, dried sewage sludge, industrial waste water, tar products, petroleum, coke, paint

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[4] Bullock P (1993) 'Energy from municipal solid waste' *Incineration an option for waste management.* Proceedings of a seminar on incineration of domestic waste, CEPA, Pavillion Hotel, Canberra, 30 November 1993, p.107.

[5] Benkendorff, Evidence, p.433.

[6] Robinson, Evidence, p.660.

varnish, waste oils and tyres.[7] In Europe, the cement kilns use sewage sludge, refuse derived fuels, paper, waste wood and waste plastics.[8]

6.5 Waste materials may be used as substitutes for 50 per cent of the fossil fuel currently used. Waste oils and solvents are being used at two sites in Australia, and tyres are also being trialled.[9] The use of steel radial tyres can improve the quality of the clinker.[10]

6.6 Extensive tests have shown that the burning of waste in kilns has no adverse effect on the cement.[11] The Blue Circle Southern Cement plant at Waurn Ponds in Victoria burns 18 000 tonnes of waste oils per year and has installed a whole tyre burning plant at a cost of $3 million, which is equipped to use 1.5 million tyres.[12] The Berrima Cement Works burn a high ash coal which has no other use.[13]

6.7 There appears to be no adverse effect on emissions from burning waste and there appear to be minor improvements in NO_x levels.[14] The Committee was told that in Europe, cement plants are burning wastes in health resorts.[15]

6.8 The Independent Panel on Intractable Waste found that cement kilns, properly modified and operated, can safely destroy low levels of

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[7] Douglas, Evidence, p.783-784; The Cement Industry Federation Limited, Submission No.54, p.1; Benkendorff P (1993) *Use of Wastes in Cement Kilns*, Paper presented to the Waste Seminar, University of New South Wales, 10 November 1993, p.6.

[8] Plastics industry Association Inc, Submission No.59, p.4.

[9] Adelaide Brighton Cement Ltd, Submission No.26, p.1-2.

[10] Hyman, Evidence, p.91.

[11] The Cement Industry Federation Limited, Submission No.54, p.2.

[12] Blue Circle Southern Cement, Submission No.75, p.2; Benkendorff, Evidence, p.433.

[13] Benkendorff, Evidence, p.433.

[14] Ibid, p.434.

[15] Ibid, p.435.

most organic chemical wastes, including PCBs.[16] The Panel considered that a great deal of such waste is less hazardous than coal and could, in part, replace coal as a fuel.[17]

6.9 The use of waste oils and tyres provides the environmental benefits of avoiding the potential adverse effects of their inappropriate use, storage or disposal, such as fire hazards or the contamination of underground water.[18] In Western Australia, tyres are used for the rehabilitation of a quarry[19] which might otherwise have been used in cement kilns. In other areas, companies interested in recycling tyres have had difficulties in acquiring an adequate supply.[20]

6.10 Worth Environmental Pty Ltd is a Victorian company which processes flammable and non-flammable organic wastes and produces a supplementary fuel which is used by cement companies. The demand for this product is greater than the supply.[21]

6.11 Australia uses 20 kg of plastic per person: it has been calculated by the Plastics and Chemicals Industries Association that a 50 per cent recovery rate would supply 20 per cent of the fuel needed for the cement industry.[22] Avcare Limited is working with the Plastics and Chemicals Industries Association to establish an infrastructure to use a wide range of plastic materials that have no current recycling use to

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[16] Independent Panel on Intractable Waste (1992) *A Cleaner Australia, Volume 1 Findings and Recommendations*, 6 November 1992, p.38.

[17] Ibid, p.38.

[18] Department of Environment, Sport and Territories, Submission No.69, p.11.

[19] Davies, Evidence, p.109.

[20] Hyman, Evidence, p.92.

[21] Davern, Evidence, p.655.

[22] Plastics Industry Association Inc, Submission No.59, p.4.

be used as fuel in cement kilns.[23] In Belgium the waste plastics from motor vehicle disassembly will also be used in cement kilns.[24]

6.12 Domestic waste contains 7-8 per cent by weight of plastics which is equivalent to 300 000 - 400 000 tonnes per year.[25] This weight of plastic has an energy equivalent to the same weight of natural gas or fuel oil, or 450 000-600 000 tonnes of black coal, or 1 500 000 - 2 000 000 tonnes of brown coal.[26]

6.13 Contaminants stored in farm chemical containers may remain in the plastic.[27] The industry is therefore investigating the possibility of using these plastic containers as fuel in cement kilns.[28] This disposal method makes use of existing processing infrastructure and avoids the disposal of these containers to landfill.[29]

6.14 Cement kilns operate at relatively high temperatures, and have a long residence time, which ensures destruction efficiencies of 99.99 per cent for organic wastes and may therefore be particularly suitable for the burning of farm chemical containers.[30] However, due to the accumulation of alkali salts, the maximum proportion of chlorinated wastes which can be used in cement kilns is less than 5 per cent of the total fuel input.[31]

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[23] McGuffog, Evidence, p.552.

[24] Plastics Industry Association Inc, Submission No.59, p.4.

[25] Pesudovs D (1993) 'The role of plastics in the waste to energy stream' *Incineration an option for waste management.* Proceedings from a seminar on Incineration of domestic waste, CEPA, Pavillion Hotel, Canberra, 30 November 1993, p.116.

[26] Ibid, p.116.

[27] Avcare Limited, Submission No.44, p.8.

[28] Ibid, p.1.

[29] McGuffog, Evidence, p.552.

[30] Avcare Limited, Submission No.44, p.9.

[31] Victorian Government, Submission No.83, p.4.

6.15 Avcare Limited noted that the supply of plastic farm containers may be seasonal and might need to be integrated with other plastic sources, such as household waste.[32] The economics of the use of plastics as an alternative fuel depends on the cost of landfill, collection, separation and preparation, transport, capital investment and the cost of other fuels.[33]

6.16 Environmental Toxicology International have produced a report entitled *All Fired Up: Burning Hazardous Waste in Cement Kilns.*[34] The report concluded that a properly operated cement kiln does not pose a public health risk when a portion of the conventional fuel is replaced by hazardous waste.[35]

6.17 Sulphur and chlorine gaseous compounds are absorbed in the raw materials, and heavy metals become part of the clinker, and therefore the process should be ideal for destroying most hazardous wastes.[36] Some adjustments may need to be made to accommodate the ash and gases given off during the burning of waste.[37] It was the view of Blue Circle Southern Cement that the industry would not compromise the quality of the cement to dispose of waste.[38]

6.18 The Independent Panel on Intractable Waste found that cement kilns were a proven technology capable of burning large quantities of liquid non-Best Available Technology and low level intractable wastes

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[32] Avcare Limited, Submission No.44, p.9-10.

[33] Plastics Industry Association Inc, Submission No.59, p.5.

[34] Environmental Toxicology International Inc and The Combustion research Institute (1992) *All Fired Up Burning Hazardous Waste in Cement Kilns.* Environmental Toxicology International Inc.

[35] Ibid.

[36] Benkendorff P (1993) *Use of Wastes in Cement Kilns*, Paper presented to the Waste Seminar, University of New South Wales, 10 November 1993, p.1.

[37] Blue Circle Southern Cement, Submission No.75, p.1.

[38] Ibid, p.1.

and some solid wastes.[39] The incineration of municipal solid waste and hazardous, intractable and liquid wastes are gaining acceptance as fuels for cement kilns in a number of overseas countries.[40]

Extenders in Cement

6.19 Cement kilns can also use fly ash, slag and silica fume as extenders, which reduces the amount of clinker that is required.[41] This aspect was covered extensively in the Bureau of Industry Economics Report in 1992.[42] The extent to which these can be utilised depends on their proximity to the cement works and the demand from the local construction industry.[43] There is also some market reluctance to these products, as well as technical drawbacks.[44]

6.20 Materials that can be blended with cement include iron blast furnace slag, fly ash from black coal power stations and silica fume.[45] These materials enhance the properties of the concrete,[46] and are currently used where economically available and there is a market for the product.[47]

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[39] Independent Panel on Intractable Waste (1992) *A Cleaner Australia, Volume 1, Findings and Recommendations,* 6 November 1992, p.38.

[40] Jones P and Herat S (1992) 'Incineration of wastes in cement kilns' *11th international Conference of the Clean Air Society of Australia and New Zealand,* Brisbane, 5-10 July 1992.

[41] The Cement Industry Federation Limited, Submission No.54 , p.2.

[42] Bureau of Industry Economics (1992) *Cement Extenders in Australia,* Research Report 45, AGPS, Canberra.

[43] The Cement Industry Federation Limited, Submission No.54, p.2.

[44] The Cement Industry Federation Limited, Submission No.54, p.3.

[45] Ryan, Evidence, p.777-778.

[46] Ibid, p.778.

[47] Ibid, p.781.

Stabilisation and Solidification

6.21 Various cement, slag and fly ash blends are marketed for stabilisation of soil and wastes.[48] The use of cement for the stabilisation and solidification of waste in cement is relative new in Australia, although used extensively in North America.[49] Portland cement use this for the solidification and stabilisation of oil sludge.[50]

6.22 The Urrichem Stabilisation/Solidification Process is considered by Solidmuti Pty Limited to provide a cost effective, safe, secure final disposal of toxic organic and inorganic wastes.[51] This technology uses Pozzolan-Portland cement-based stabilisation/solidification processes to produce a waste/concrete composite.[52]

6.23 The solidified waste has high mechanical strength and stability, and has been tested by the US EPA.[53] This technology can be used for other process waste, such as incinerator ash, and mixtures that cannot be treated effectively by other means.[54]

6.24 Trace quantities of heavy metals are not of concern because of the large quantities of clinker throughput.[55] The cement industry is developing a range of special cements for encapsulating heavy metals.

6.25 This technology can be used to solidify liquid waste at source, avoiding transport risks. It can be disposed of in non-secure landfill

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[48] Benkendorff, Evidence, p.433.

[49] Ryan, Evidence, p.781.

[50] Ibid, p.781.

[51] Solidmuti Pty Limited, Submission No.18, p.3.

[52] Solidwaste Technology, *Stabilisation and Solidification of Mercury-containing Sludge at the Jen-Wu Plant Site of Formosa Plastics Corporation, Kaohsiung, Taiwan, with the Urrichem Process*, p.1.

[53] Solidmuti Pty Limited, Submission No.18, p.3.

[54] Ibid, p.4.

[55] Benkendorff, Evidence, p.433.

sites, or it can be pumped into secure landfill sites and solidified *in situ*.[56] This process could also be used for the reclamation of sites.[57] This process is being used at Willawong, where residues are fixed in cement and fly ash and removed to Gurulmundi.[58]

Industry Policy

6.26 The Committee was told that the policy of all Australian cement companies was not to burn toxic waste in the kilns, and that they had no aspirations to become involved in this process.[59] Blue Circle Southern Cement Limited pointed out that the companies are in the business of selling cement, and the use of wastes for fuels is only a minor part of the total process.[60]

6.27 The costs of waste disposal using cement kilns are low in comparison to some other waste disposal processes.[61] The cement companies in Australia would prefer to have government and community confidence before undertaking the required significant capital investment.[62]

6.28 The Victorian Government pointed out that:

> many older kilns have a history of poor environmental performance resulting in long-standing problems of particulate fall-out in neighbouring areas. As a result, community confidence in the ability of

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[56] Solidmuti Pty Limited, Submission No.18, p.4.

[57] Ibid, p.5.

[58] Doolandella, Pallara and District Residents Association Inc, Submission No.73, p.5.

[59] Ryan, Evidence, p.784.

[60] Blue Circle Southern Cement, Submission No.75, p.1.

[61] Benkendorff P (1993) *Use of Waste in Cement Kilns,* Paper presented to the Waste Seminar, University of New South Wales, 10 November 1993, p.1.

[62] Blue Circle Southern Cement, Submission No.75, p.2.

> the industry to manage the disposal of chlorinated wastes is relatively low.[63]

6.29 The Committee was told by Blue Circle Southern Cement that:

> the cement industry is confident in its ability to meet limits within environment legislation. However, the possibilities have been raised overseas that cement producers burning waste have stricter limits than producers not burning wastes. Also, it appears that some other potential users of the waste, particularly those operators with government influence, or electricity producers, have less strict requirements and thus an advantage.
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> Environmental limits should be set for the cement industry as a whole and these limits or some other mechanism, should recognise the threat of imports from countries with less environmental concerns.[64]

6.30 Currently, no chlorinated or chlorine-contaminated materials can be burnt in cement kilns in Victoria.[65] The lack of defined permissible management and emission criteria for cement kilns burning plastic is hindering this process.[66]

6.31 ICIA considered that cement kilns in Australia might adequately deal with Hexachlorobenzene wastes from its Botany plant, but pointed out that problems associated with community concerns and transportation would require the demonstration of this method on more intractable waste.[67]

6.32 Similarly, there is little enthusiasm by the industry for incorporating hazardous materials in cement. Concrete's high strength, low permeability and resistance to most chemicals makes it an ideal material for waste containment.[68] The incorporation of waste in

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[63] Victorian Government, Submission No.84, p.4.

[64] Blue Circle Southern Cement, Submission No.75, p.2.

[65] Victorian Government, Submission No.83, p.2.

[66] Avcare Limited, Submission No.44, p.1.

[67] ICI Australia Operations Pty Ltd, Submission No.55, p.7.

[68] The Cement Industry Federation Limited, Submission No.54, p.3.

cement can interfere with the cement setting process, producing a material of poor mechanical strength and durability.[69] The processes of solidification and stabilisation have received considerable attention in the United States.[70]

Concluding Comments

6.33 There are a number of other reasons that waste has not been used in cement kilns, including the low prices to landfill materials in Australia, the lack of adequate legislation on waste disposal, no co-operative approaches from government and municipal authorities, industry concern about unfounded public reaction, concern about product quality and perceptions of product quality and concern about companies using wastes being subjected to stricter controls than those using other fuels.[71]

6.34 The advantages of using cement kilns to treat wastes are that it is a well known technology capable of destroying most wastes, it can handle large quantities, little additional capital is required, there are no additional operating costs, no increase in emissions and no production of waste.[72]

6.35 The Committee was told that Brambles suffered a $3 million loss in a venture to set up an incinerator in the United States because the waste suddenly all went into cement kilns instead of being available for burning in the incinerator.[73] Additional information on the potential for cement kilns to deal with the waste requiring disposal should be investigated prior to the approval of the construction of substantial incinerators.

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[69] White, Eaton and Kyle, Submission No.72, p.15.

[70] Adaska W, Tresouthick S and West P (1991) *Solidification and Stabilisation of Wastes Using Portland Cement*, US Portland Cement Association

[71] Benkendorff, Evidence, p.434.

[72] Ibid, p.432.

[73] Ewald, Evidence, p.443

6.36 The Committee believes that this option has not been used to its full potential in Australia, and would like to see further research into this possibility.

6.37 Accordingly, the Committee recommends that:

Recommendation 6

The Committee recommends that the Government investigate the potential and feasibility of using cement kilns for disposal of particular waste streams.

6.38 A matter of concern to the Committee is that if this industry and a number of other industries take up the option to use tyres and other supplementary fuels, there will be insufficient supply. Enterprises which have established processes to reuse tyres will no longer be guaranteed a sufficient supply to be commercially viable. The Committee believes that the reuse of materials should be given preference over their use as a fuel. Accordingly, the Committee urges governments to assess the situation as the need arises.

6.39 The Committee recommends that:

Recommendation 7

The Committee recommends that the Government investigate the avenues available to regulate the use of materials for recycling, in preference to their use as a supplementary fuel.