David Mooney - Submission Details for Erica Loh (object)

From: "Erica Loh" <m96vtck@gmail.com>
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Date: 6/11/2013 11:36 AM
Subject: Submission Details for Erica Loh (object)
Attachments: Moorebank recycler protest letter.1.pdf; Rebuttal against MRF report.pdf; REFERENCES.1.pdf

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NSW GOVERNMENT | Planning & Infrastructure

Confidentiality Requested: no

Submitted by a Planner: no

Disclosable Political Donation: no

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Content:
This proponent PPR is irresponsible and is against the public interest. PAC is commissioned to to decide for the best interest of the community and must do the right thing in REJECTING this proposal.

Attached are my points and references:

- Moorebank Recycler protest letter
- References
- Rebuttal against MRF report

IP Address: - 210.80.194.50
Submission: Online Submission from Erica Loh (object)
https://majorprojects.affinitylive.com/?action=view_activity&id=81940

Submission for Job: #100 MP 05_0157, Moorebank Waste Facility
https://majorprojects.affinitylive.com/?action=view_job&id=100

Site: #91 Moorebank Waste Facility; , Moorebank
https://majorprojects.affinitylive.com/?action=view_site&id=91

Erica Loh

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<u>OPPOSITION TO THE MOOREBANK WASTE FACILITY (MP 05_157) PPR</u>

This so-called "preferred project" report is absolutely biased for Moorebank Waste Recycling Plant and should not be used as evidence to support its approval by the PAC.

A few protest points I would like to point out:

1. The project preference report does not indicate the closest distance of this polluting factory to the nearest affected residential house. I live in Conlon Ave where the distance is one of the closest to this plant (about 200m). This road is in direct line of sight of this pollutants generating plant. This information is convenient missing and entirely mislead the public and PAC assessors on of how extremely close the distance between the plant and residential houses. If this plant is being approved, it would be one of the first ever construction waste recycling plant closest to residential houses.
2. Statement at clause 1.1 having misleading and untrue information in regards to only a small section of residential area is near to the site. How can this statement be put into the report as there is already 1000 houses built in Georges Fair?!! This number has not even includes the long existing residential area next to Georges Fair between Newbridge Road and Brickmakers Road.
3. Taking into consideration such a massive capacity 500,000 tonnes per annum, this waste recycling plant is expected to process 1602 tonnes per day, 6 days a week, 11 hours a day from 7am to 6pm. With the limited number of workers onsite and without mentioning about other machinery resources to prevent asbestos being processed at the facility, **how can Moorebank Recycler assure that all the waste materials are free of asbestos?**
4. The report is clearly stated that the recycled material consist of concrete, brick, asphalt, sandstone and sand. By all means, all these materials are actually very hazardous to human. Reference 1 & 2 clearly stated the danger of Asphalt and breathing in silica dust.
5. Poor site maintenance practise may incur mosquitoes, weeds, pests or vermin which will subsequently impact the Georges River environmental condition.
6. Clause 1.4.3 never consider and mention the impact of the dust generation, air contamination when the recycling material is exposed during transportation or material and handling of the materials between the crusher and machinery throughout the whole operation.
7. The operating hours are **<u>ridiculously long</u>** and even operating on Saturdays whereas the residents nearby are mainly spending the weekend as family day. In addition, operation hours during the weekday does not mean will not impact the resident as many family are still spending their time at home especially the retirees, preschool children, and home makers mum.
8. Section 2.3.2.3 comparing the additional traffic 1-2 trucks every 2 minutes should not be considered equal to the vehicles addition as the pick up speed of the truck is entirely different from a normal passenger car vehicles. Addition of 1-2 trucks in such a short time will definitely cause the massive traffic disturbance without considering the massive size of the truck, the pick up speed of the truck, hazard of the truck bring into the road safety, smoke of the truck exhaust due to most truck are poorly maintained and damage on the road condition.

9. Clause 2.4.2.8 taking a general statement from a Senate inquiry without the detail of the scientific aspect and detail of the issues of the inquiry to argue that silicosis is not a community problem is **totally unacceptable** as the evaluation should be case to case basis.
10. Clause 2.4.2.7 Poor standing of promises stated in the report such as performing asbestos screening without stating how to ensure the implementation and monitoring the effectiveness of the implementation. The site safety plan on the inspection process is poorly described without clearly stating how to manage the inspection of 1602 tonnes material per day. If only sampling inspection is performed, this also means that there is a risk that asbestos material will slip through and get into the recycling. Again, how can a normal staff differentiate asbestos from all the powdery substances of incoming construction wastes? **Gyrock, crushed rocks, sands all mixed up even with asbestos cannot be visually differentiated at the incoming point.**
11. Clause 2.14 stated that the land value of the residential area is not a consideration of the assessment is absolutely contradicting with the point that Moorebank Recycling Plant raise to support the 25 number of local jobs created. The **damage of the local economy** due to polluted suburb reputation, community being constantly exposed to health pollutant hazards and subsequently depreciation of property values is definitely far more devastating than just a mere number of jobs created.
12. The numerous numbers, tables and graphs churned and displayed in the report are merely theoretical, especially the dust and noise aspects. These are generated based on estimation models without any actual continuous monitoring of a similar operating plant. Merely stating that these numbers are acceptable is too much of assumption to make.

In conclusion, this PPR report is entirely nonsense and biased towards supporting the building of this construction waste recycling plant.

Reference:

1. :Alsphalt Hazardous Substance Fact Sheet
   http://nj.gov/health/eoh/rtkweb/documents/fs/0170.pdf
2. :The Dangers of Breathing Silica Dust
   http://www2.worksafebc.com/i/posters/2009/WS%2009_04.html

3. Danger of disposal of Copper Chrome Arsenate Timber pg 2 (Attached Reference 3)

4. Health effect caused by cement. (Attached Reference 4)

5. Effect of Chronic Cement Dust Exposure on Lung Function.. (Attached Reference 5)

6. Impact of Dust Emission on Plant Vegetation in the Vicinity of Cement Plant.
   (Attached Reference 6)

7. When People and Industry Live Side-by-Side: Health Impacts of PM Pollution
   http://www.psr.org/environment-and-health/environmental-health-policy-institute/responses/when-people-industry-live-side-by-side.html

Rebuttals to the Moorebank Recycler "Preferred Project" report

The mere naming of this report by Moorebank Recycler is totally misleading as this is definitely NOT "Preferred" by the whole community breathing and living surrounding this polluting proposal. This so-called Preferred Project report is initiated and financed by Moorebank Recycler thus is strongly bias toward presenting false and misleading "evidences" or assumptions to get the polluting factory approved by PAC.

Section 1.3 in the report clearly shows the Boral Moorebank Structure Plan 2002 indicated the Moorebank Recycler parcel and Benedict Sand parcel as Waste and Recycling uses/Open Space (Other uses subject to detailed investigations). Liverpool Council, being a very conscientious and pro-community council has great plans to beautify this part of the council precinct and started to move towards this direction. In LEP3008, Moorebank Recycler's parcel has been zoned as E2 Environmental Conservation with Clause 11. This clause explicitly provides a sunset time limit for any waste factory to be built within deadline of 1 September 2018. It is clear that Liverpool Council is proactive yet sensitive and sympathetic towards businesses such as this landfill owner now known as Moorebank Recycler, in giving this company ample time (2002 to 2018) to submit their voluntary prezoning submission to improve their land purpose. Another company, Benedict Sands, being a very much more forward-looking has in fact submitted plans to close their sandmining operation and replace it with a functional and magnificent marina, suiting the recreation purpose of Georges River. On the other hand, Moorebank Recycler has and is still adamant to be stuck in polluting industry, thus pushing this waste recycling plant proposal through Part 3A process. Moorebank Recycler has turned around and bite the Liverpool Council's hand of generosity and is trying to completely destroy the improvement of this ex-Boral land parcel.

The numerous reports financed by the proponent MRF tried to mislead the public and PAC that this proposal has negligible impact on air quality, noise, visual impact. Yet, the numbers from these reports are mere estimation based on fancy sounding models, not actual concrete numbers from any similarly existing waste recycling plant. Hidden somewhere in Attachment 11 of Pacific Environment Limited Air Quality report is a section showing existing Dust Control procedure at 11 **Thackeray Street, Camellia**. MRF has been operating this polluting plant for such a long time under the banner of Concrete Recycler. **Why are the air quality, noise, dust, visual impact studies not conducted on this existing factory surroundings?** This existing plant is much smaller than the proposed MRF at Moorebank yet emitting high pollution in all aspects. Once actual readings numbers are obtained from this existing plant, these can be extrapolated to the 500,000 tonnes per annum operation. These numbers will be much more representative of how badly the air quality will be affected and noise increased once MRF start operating.

Section 3.1.1 Site Access of the Proposed Amendments contains the Cardno plans which clearly show ramps for access of this MRF. Any trucks, especially the huge 23 tonnes trucks, straining to go up the short steep ramp to cross the bridge will surely result in the following:-

- Backing up the traffic at Brickmakers road, all the way till Newbridge Road, since these ramps are merely less than 300m from the Newbridge intersection. With 324 trucks movement daily, this traffic jam will last the whole day, disrupting the flow of passengers cars from Georges Fair community and any passing vehicles. It is likely that the whole Milperra section of Newbrige Road will piled up with MRF trucks queuing to access these ramps.

- Excessive smoke from the trucks, polluting the surrounding air, especially the Georges Fair residential area.
- Increase noise volume and amplitude from the trucks engine struggling to go up the ramps.

These results completely negate the responses of the proponent in section 2.3, 2.4, 2.5. The proponent conveniently avoids addressing the struggling truck movements up the ramps in Cardno Plans, hoping to hoodwink PAC by merely showing numbers. Note too that all the numbers in the proponent report is merely assumptions without any actual existing facility study. MRF purposely avoid putting forward a study of actual numbers at the existing Concrete Recycler plant at Camelia, where trucks movement pose daily dangers and hazards to residents nearby.

If the proponent MRF is really serious and concerned of mitigating visual impact, they should not have proposed a stockpile height of 10m. Even in section 3.1.3 Amended Stockpile Height, MRF is only proposing limiting the stockpile height to 7 m, which is higher than the western boundary bund of 6m. And if MRF really wanted to be environmentally responsible, the company should not even propose building such a polluting plant next to an environmentally sensitive river ecosystem of Georges River. The fact that the proponent tried to play down the ecosystem sensitivity of the Georges River in page 3-27 does not give this MRF the right to further damage and pollute the river more.

Section 3.2.8 Flora and Fauna, MRF readily acknowledge the proposal will threaten the local flora and fauna, yet the mitigating measures are just credit offsets which do nothing good for that localised damaged flora and fauna.

What good do the list of Statement of Commitments do when the proponent got approval to pollute the complete surrounding communities with asbestos dust, kills the ecosystem of the river and thorough ruin the lives and health of people; children, families, retirees within 2km of this plant? Will the state government be responsible for compensations in the future? Will the EPA which seems to appear ignorant and flippant in their letter under Attachment B (part of Attachment 12), be responsible for subjecting so many residents to noise stress and highly likely asbestos dust exposure?

Will this be another James Hardie episode?

The blood of people will be on Planning Assessment Commission hand, the state government hand and the Planning Minister Brad Hazzard's hand if this proposal gets the go-ahead.

REFERENCES

REFERENCE 3

Department of
Environment and Conservation

Our environment, our future

Environmental guidelines

for

construction and demolition waste recycling facilities

September 2009

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Introduction

The construction and demolition waste recycling industry is a growing supplier of civil engineering materials in Western Australia. The availability of recycled products that meet end-user specifications reduces the demand on quarried materials. The industry already produces a range of products that are used in drainage applications and for road-making. Blended recycled materials can also be used as inert fill for land contouring and as admixtures in brick-making.

Recycling facilities have the potential to impact on the local environment. Facility operators are required to hold a current licence issued by Department of Environment and Conservation (DEC). Site operations can generate dust, litter, create offensive noise or result in unauthorised discharge of sediment and/or contaminated water.

A typical recycling facility receives mixed, partially mixed or source-segregated construction or demolition waste. Loads are visually assessed for contamination, such as asbestos. They are then processed to extract any readily recyclable materials such as metals, plastic or paper. The types of process used may be fairly simple ranging from manual separation or separation using a front end loader, to more advanced systems using conveyors, trommels, magnetic separators, crushers, grinders and graded screens. The remaining mix can consist of concrete, bricks or general rubble, and might be further graded, or crushed and screened, to produce a specific mix.

Better economic outcomes are achieved where a facility produces a material that conforms to a product specification accepted by end-users. The supply of a product that is not 'fit for purpose' reduces market confidence in the use of recycled aggregates. Facility pricing policies may need to be adjusted or waste acceptance criteria set and enforced by operators to exclude contaminants from loads. Feedstock quality and process control are needed to ensure products meet specification and comply with all relevant regulations.

Purpose of this document

This document is intended to provide proponents, owners and operators of building product recycling facilities with guidance on standards of environmental performance needed when recycling construction and demolition waste. Environmental issues associated with sorting and processing construction and demolition waste are identified. The desired outcome is then described. Specific safeguards and operational measures are also suggested. Operating practices are suggested that are intended to maximise the opportunity for recovery of resources.

It is not intended that this document be prescriptive or a fully comprehensive "how to" Guide. Compliance within the contents of this document does not alter any requirement for owners to fully comply with all relevant legislation and regulations. It is also likely that individual sites will encounter site-specific issues that might not be covered by these Guidelines. Each site will need individual assessment by owners and operators.

Some of the most relevant environmental laws and regulations that apply to building product recycling facilities are highlighted to assist owners and operators.

These Guidelines do not discuss the economics of operating a construction and demolition company nor the impact of the economies of scale of such facilities.

General principles

The performance outcomes described in this document are based on the following principles and objectives. Each represents an individual goal in its own right. The achievement of the performance outcomes described in this Guideline will contribute to meeting these goals and result in improved local environmental conditions through more sustainable management of building product recycling facilities.

1. Protection of public health
2. Protection of the environment
3. Resource Efficiency
4. Principles of Sustainability

Protection of public health

It is important that public health considerations are not overlooked in pursuit of higher order environmental objectives. Poorly managed landfills or recycling facilities can increase such risks, for instance by allowing water to pond and mosquitoes to breed. Construction and demolition waste recycling facilities will also receive materials that may contain substances that are toxic in the environment and may threaten human health. Specific types of asbestos are known to cause cancer in humans. There is concern over the use and disposal of Copper Chrome Arsenate (CCA) treated timber, used widely over the years in landscaping, outdoor structures and civil engineering applications. CCA-treated timber must be disposed of in a licensed landfill. Any pesticides, creosote or chemically treated timber, or under-slab treatments need special management, if present. Paints, solvents and chemical adhesives are also common and need to be segregated before processing.

Recycling facilities must therefore develop management practices based on a risk assessment to manage specific products or materials identified as contaminated. Operators may elect to have a policy of not accepting loads if the presence of any quantity of contaminated material is found.

Protection of the environment

DEC is responsible for administering and enforcing the *Environmental Protection Act 1986* and associated Regulations. It is also responsible for managing the *Contaminated Sites Act 2003* and the *Waste Avoidance and Resource Recovery Act*

2007 and associated regulations

It is important that construction and demolition waste recycling facilities are managed to prevent negative environmental impacts. Recycling facilities provide significant environmental benefits by removing products from the waste stream and converting them into reusable products. The efficient operation of reuse and recycling operations conserves the State's natural resources by reducing the need for new quarries with associated habitat loss. They also reduce the energy input into construction as it is more efficient to reprocess demolition materials than to quarry new resources.

Resource efficiency

The Waste Avoidance and Resource Recovery Act 2007 is the primary piece of legislation for waste management in Western Australia. The objectives of the Act are to contribute to sustainability, and the protection of human health and the environment in Western Australia and the move towards a waste-free society by –

a) Promoting the most efficient use of resources, including resource recovery and waste avoidance; and
b) Reducing environmental harm, including pollution through waste; and
c) The consideration of resource management options against the following hierarchy –
    I. Avoidance of unnecessary resource consumption;
    II. Resource recovery (including reuse, reprocessing, recycling and energy recovery);
    III. Disposal.

The waste management hierarchy provides a useful approach for assessing options and deciding on the most desirable end use for wastes or materials. The objective is to adopt the end use that is at the top of the hierarchy.

Table 1 - Applying the waste management hierarchy to construction and demolition waste

Waste management hierarchy	*Potential responses*
1. Reduce	Includes building design and building life cycle assessment, design for deconstruction, adaptive reuse of existing buildings, use of new materials and technologies with increased reliance on recyclable building components
2. Reuse	Recovered construction and demolition waste particularly hardwoods, warehouse & wharf timbers, aluminium window & door frames, roof tiles, bricks, window glass, and other materials for resale should be segregated and on-sold to salvage yards. Direct re-use applications for non-segregated or unprocessed building waste is limited to site pre-loading or site contouring, or disposal to landfill which will be utilised after closure.
3. Recycle	Road bases and sub-grade materials, drainage medium, backfill material, civil construction, compacted hard stands, sealed and unsealed roads. Concrete aggregate and glass used in the manufacture of concrete kerbing or pedestrian pathways.
4. Disposal	Disposal in landfill for non-specific use.

The principle of "Resource Efficiency" recognises that valuable resources and energy were used to make these materials in the first place. The end use should therefore make the best use of this resource and minimise any additional energy used. Embedded energy whilst valuable must be balanced against transport energy if a product needs to be carted a significant distance for reprocessing.

The hierarchy provides a simple tool to guide decision-making. There will be specific circumstances where the result suggested by the hierarchy might not apply, for instance where infrastructure or markets for recycled products are as yet undeveloped. In general, applying the "resource efficiency" principle will provide better environmental outcomes.

Principles of sustainability

The WA Government has made a commitment to sustainability through the release of the State Sustainability Strategy. The main principles of sustainability are:

1. The precautionary principle;
2. The principle of intergenerational equity;
3. The principle of biological diversity and ecological integrity; and
4. Principles relating to improved valuation, pricing and incentive mechanisms.

For the purposes of this Guideline, the definition of these principles is taken to be as detailed in Section 4A of the *Environmental Protection Act 1986*.

Definitions

Construction and demolition waste recycling facility

means "a facility able to accept construction and demolition waste material to sort, disassemble, screen or make available for reuse or recycling."

The quality of the material used to produce the recycled material and the amount of sorting, disassembling or screening will all impact on the nature of recycled material produced. A typical construction and demolition waste processing facility will have the following equipment:

- Primary sorting (generally based on selective dumping of wastes)
- Primary crushing
- Secondary sorting, possibly with an electromagnetic conveyor
- Primary screening of crushed material
- Secondary crushing
- Secondary screening
- Final sorting

Construction and demolition waste material

means "the excess or waste material arising from the construction and demolition of buildings and structures or pavements. It includes concrete, brick, rubble, asphalt, metals (ferrous and non ferrous), timber, wallboard, glass, plastics, asbestos, soil and other building materials and products."

Potential issues in siting and managing construction and demolition waste recycling facilities

The selection of potential construction and demolition waste recycling facilities sites need to consider constraints such as buffer distances for dust and noise control, traffic management, planning requirements and costs.

Generally sites would be in industrial or special industrial zoning areas, or an existing or future landfill site or quarry. Many industrial areas would not be acceptable due to the predominance of light service industries and their likely objections about the reduction of visual amenity and dust emanating from the facility. The most likely location for a construction and demolition waste recycling facility is at an existing landfill site. Generally sufficient buffer distances can be provided with the landfill site and the existing landuse complements the requirements of a processing facility.

Operators of construction and demolition waste recycling facilities need to be aware of a number of potential issues which can cause a local nuisance or disturbance for neighbours which may be an offence. In addition, there are issues that may cause actual and material environmental harm. This constitutes a number of potential and more serious environmental offences for which severe penalties apply.

Table 2 provides a summary of the environmental issues that need to be addressed in site selection and operating practices. These are:

- Noise
- Air Quality
- Water Quality
- Land Use
- Flora and Fauna
- Litter issues

The common activities associated with transporting, processing and recycling of used building products are listed, showing the possible results and the potential impacts to be avoided. The most relevant environmental legislation is also highlighted where appropriate.

It is the responsibility of owners and operators to ensure compliance with all relevant environmental or other legislations. This document can be used for facilities operating on both state and federal land but further clarification from the federal government would need to be established prior to commencing operations.

It is recommended that the operator of a construction and demolition waste recycling facility should prepare a detailed Environmental Management Plan on how it will manage the site, how it will avoid environmental pollution and how it will respond in cases of various forms of possible environmental incidents.

Facility operators are encouraged to help transform their business from simple waste management to one of secondary resource recovery. This opens market opportunities for the business and helps conserve the State's natural resources.

Table 2: Summary of main issues for recycling construction and demolition waste

Activity	Potential result	Impact	Relevant Acts / Regulations
Site clearing	Dust and Noise	Health	*Environmental Protection (EP) Act 1986* section 49 (causing pollution and unreasonable emissions).
		Air pollution	Conditions imposed under relevant planning approvals.
		Amenity	*Environment Protection (Noise) Regulations 1997.* Local Government Bylaws
	Loss of Biodiversity	Flora and fauna habitats	*Environment Protection (Clearing of Native Vegetation) Regulation 2004* *Environmental Protection Act 1986* – section 50A (causing serious environmental harm). Local Government Bylaws
Transporting materials to or from site or stockpiling of wastes or recycled products on site Wind movement across unsealed areas	Dust	Health Air pollution Amenity	*Environmental Protection Act 1986* section 49 (causing pollution and unreasonable emissions). *Environmental Protection Regulations 1987* (Licence may be required under Schedule 1 – Part 1 - Categories 13, 61A, 62 or 63). Local Government Bylaws
Crushing, grinding or screening operations	Noise	Amenity	*Environmental Protection (Noise) Regulations 1997* Local Government Bylaws
Site operations or contouring that permits water to pond on-site.	Odour	Health Amenity	*Environmental Protection Act 1986* section 49 (causing pollution and unreasonable emissions). Local Government Bylaws
Poor site maintenance practices	Mosquitoes, weeds, pests or vermin	Flora and fauna impacts	*Environmental Protection Act 1986* – Section 50A if licensed, otherwise section 182 of the *Health Act 1911*. Local Government Bylaws.

Uncontrolled or poorly managed site run-off. Poorly maintained or inadequate site access roads or drainage systems.	Surface water run-off resulting in transport of sediment, erosion	Water pollution	*Environmental Protection (Unauthorised Discharge) Regulations 2004.* *Environmental Protection Act 1986 Section 49* (causing pollution and unreasonable emissions). *Water Quality Protection Notes*, Department of Water Local Government Bylaws
Diesel, oil or other leaks or spills Poor design or management of fuel or hazardous goods storage areas.	Site or groundwater contamination	Land contamination	*Contaminated Sites Act 2003* *Environmental Protection (Unauthorised Discharge) Regulations 2004.* *Dangerous Goods (Storage & Handling of Non-Explosives) Regulations 2007.* Local Government Bylaws
	Diesel, oil enters drainage systems	Water pollution	*Environmental Protection Act -1986* Section 49 (causing pollution and unreasonable emissions). Section 50 (discharge of waste likely to cause pollution). Local Government Bylaws
Asbestos contamination in waste loads	Asbestos pieces pass through crushing operations	Air pollution	*Environmental Protection (Unauthorised Discharge) Regulations 2004* *Health (Asbestos) Regulations 1992.* Regulation 11 (asbestos for disposal to be separated). Local Government Bylaws
	Asbestos from stockpiled material remains in soil	Land contamination	*Contaminated Sites Act 2003* *Contaminated Sites Regulations 2006* Local Government Bylaws
Litter	Litter that is a result of operations or during transport to/from site	Litter	*Litter Act 1979* *Local Government Bylaws*

Noise issues

Construction and demolition waste recycling facilities are reliant on the use of heavy vehicles and specialised site plant and equipment. The type of equipment which would create a noise issue includes grinders/crushers, sorting conveyors, loading and unloading of trucks, as well as vehicle movements. Potential noise impacts need to be considered, and effective mitigation measures put in place, so that no local nuisance or offensive noise is created for nearby residents or other businesses.

Traffic

Heavy vehicles can create disturbing noise entering and exiting the facility. The siting of such facilities need to consider the traffic routes the vehicles will travel, preferably not through built-up residential areas.

Issue:	Heavy vehicles can be a common source of noise disturbance, particularly to nearby properties and along main access routes to recycling facilities, landfills and other open site operations. The movement of waste onsite and stockpiling final products can also be sources of noise disturbance.
Desired outcome:	Noise from vehicles travelling to and from the site and moving within the site does not create offensive noise levels or disturb neighbouring or nearby properties.
Suggested measures:	• Facilities should be sited within a zoned industrial estate having an appropriate buffer distance from residential areas. The *EPA Guidance for the* Assessment of Environmental Factors (Separation Distances between Industrial and Sensitive Land Uses) requires that a minimum separation distance of 1,000 metres be provided. Main transport routes to the facility should avoid residential or sensitive use areas. • Owners and operators of existing facilities should implement special noise reduction measures, such as erecting purpose-built acoustic barriers, restricting opening hours or allocating customers with specific delivery times.

On-site plant and equipment

The extent to which plant and equipment may disturb neighbouring properties will depend on local circumstances and on the nature, level or frequency of the sound emitted, its duration and the time at which it is made.

Issue:	Recycling facility plant and equipment can create noise nuisance or noise pollution if not properly managed. Crushing and grinding equipment is inherently noisy. Power screens used to grade and standardise aggregate size can also generate a significant level of noise.
Desired outcome:	Occupiers of neighbouring properties are not disturbed as a result of the use of site plant and equipment or general site activity.
Suggested measures:	• The EPA Guidance for the Assessment of Environmental Factors (Separation Distances between Industrial and Sensitive Land Uses) requires a minimum separation distance of 1,000 metres. • Sites located within an industrial estate are preferred. • Sound attenuation measures should be used for plant and equipment such as baffles and specialised mufflers, acoustic enclosures or partial enclosure housings. Advice should be sought from an acoustic engineer. Pre-sorting or pre-treatment of wastes may also act to reduce noise impacts. • Acoustic barriers need to be designed and purpose-built if needed. Vegetated buffer zones can also be planted to mitigate noise from operations using suitably selected native plantings local to the area. • All plant and equipment should be regularly maintained and. select equipment having the lowest sound output rating. • Hours of use of operation for plant and site equipment are compliant with the provisions of the *Environment Protection (Noise) Regulations 1997*. • Don't delay. Early intervention to address noise issues works best with occupiers of any affected property. Give details to the property owner of what action is being taken and the timeframe to mitigate the noise. People are usually accommodating if a solution is in sight.

Air quality issues

Dust

Dust can be generated as a result of the site activities of construction and demolition waste recycling facilities and needs to be managed to prevent local nuisance or environmental impact.

Issue:	Dust can be generated during the transportation of materials to and from the facility, from general site activity and stockpiling, and from the recycling process itself, notably from crushing and screening equipment. Dust and wind blown particles are a nuisance and an occupational health and safety hazard for facility workers. It is also a potential health hazard for neighbouring properties. For instance, dust and other particulate matter from crushing may trigger respiratory attack in susceptible people, such as asthma sufferers, affect local manufacturing businesses equipment or products (eg cabinet works) or remnants landing on motor vehicles of local business staff. Excessive dust emission can also adversely affect native flora and fauna in local bushland.
Desired outcome:	Dust should not exit the site and dust plumes should not be visible from surrounding areas. Internal and external roadways are generally free of accumulated dust, soil or sand. Excessive quantities cannot be picked up by the wind. Dust is not generated by the temporary holding of waste pending processing, or from final product stockpiles.

Suggested measures:	• Where feasible, processing operations likely to generate dust should be enclosed and provided with internal dust suppression or capture systems. • Specific measures such as using a water cart to dampen down roadways and operating areas and installing and enforcing the use of vehicular wheel wash baths. • A Dust Suppression Plan should be prepared and a copy provided to the DEC in the first instance. • A sealed road of at least 30m should be provided at the exit to the public road system, and this should be regularly swept to remove loose material. • The Public Health Bill 2008 will give local government greater ability to identify public health needs in local districts. Local Laws will be developed by local governments to manage dust issues. • Minimise the area of the site cleared for operations and seal or compact and properly stabilise access roads and hard stand areas. • A vegetated buffer zone should be provided and be planted with appropriate native flora local to the area and suitable for the various uses of visual screening, aesthetics, noise and dust control.. • Where a recycling facility is co-located within a landfill, adequate intermediate and final cover layers must be provided. Filled areas of the site should be progressively contoured, stabilised and re-vegetated.

Asbestos

Asbestos was commonly used in building products between 1921 and 1987. Asbestos can be found in a variety of products including as formwork for concrete work, exterior wall cladding and roofing. Asbestos poses a potential risk to human health if asbestos fibres become airborne during transporting, unloading and processing of C&D waste. A sampling regime should be implemented by the recycler and in conjunction with Department of Environment and Conservation who undertakes confirmatory sampling from time to time for asbestos contamination.

Issue:	Some historically used building products contain asbestos. If such material is present when crushing and screening takes place, asbestos fibres can potentially become airborne causing a health hazard. If asbestos contaminated material is sold, sites where evidence indicates that such material has been used are likely to be classified as Possibly Contaminated – Investigation Required under the *Contaminated Sites Act 2003* or maybe classified as Contaminated – Remediation Required.
Desired outcome:	Material processed and products sold by construction and demolition waste recyclers are free of asbestos contamination.
Suggested measures:	It is acknowledged that it can be difficult to see asbestos in building products waste and that this can cause problems for building products recyclers. Therefore, the best way to address this issue is to put the onus on suppliers of building products waste to certify that their material is free from asbestos. The following steps are suggested: • Familiarisation with the following documents: - *Health (Asbestos) Regulations 1992* - *Contaminated Sites Act 2003* - *Occupation Health and Regulations 1996* • A declaration to be signed by each driver stating that their load is free from asbestos should be required before material is accepted by a recycler. • In addition to this, a quality control process should be implemented whereby each load is unloaded and inspected before acceptance. • Should a load be found to be contaminated, it should be rejected by the recycler and the material be safely reloaded into the supplier's vehicle (at supplier expense). The rejected load should be taken to a licensed landfill site able to accept asbestos.

Water issues

Water issues include management of stormwater and other contributors to site surface water. A major issue associated with managing a construction and demolition waste recycling facility is the potential for storm water run-off or for contaminants to enter drainage systems and pollute local watercourses.

Surface water

Issue:	Stormwater run-off can carry dust, sediment and contaminants from the facility into drainage systems and nearby watercourses. Uncontrolled site run-off can also block or restrict drainage systems and cause local flooding and/or soil erosion. Sediment can be transported from the site causing siltation of streams and rivers. This can result in the receiving waters becoming turbid or cloudy. Aquatic life maybe adversely affected as a result of sunlight being prevented from entering the turbid water.
Desired outcome:	Local drainage systems and watercourses are free of sediments and silt and are kept free at all times of any contamination. The quality of receiving watercourses and rivers is not impacted. Aquatic life-forms and eco-systems are not adversely affected as a result of the facility operating.
Suggested measures:	• The site selected should be remote from major watercourses, streams, rivers or wetlands. • Site design measures should be adopted to divert and effectively manage any overland flows or surface water around the operating area. • Discharge of intercepted and 'first flush' surface waters to a sediment settling pond prior to a discharge from the site. • A stormwater management plan conforming to the recommendations of Chapter 7 Best Management Practice 2.2.10 of the Storm Water Management Manual for Western Australia should be adopted. • Drains and settling pond/s should be designed to accept 1 in 10 year 1 hour rainfall event. • Install and maintain geo-textile filter fences or sediment traps within drainage depressions or as needed. • Site clearing should be minimised to that needed for operations, stockpiling and access roads only. • Existing site vegetation should be retained as much as possible to limit transport of sediments. • Vegetated buffer zones should be planted using suitably selected native plantings local to the area.

Land issues

The major capital expenditure in operating a construction and demolition waste recycling facility is typically for acquiring the site and meeting associated design and construction costs. Responsible site management practice, prudent risk management measures and making adequate provision for legal and financial assurance of post-closure after-care are all essential for ongoing environmental protection and in securing a guarantee that the stored resource will be accessible when needed.

Site contamination

Remediation of contaminated soil is difficult and expensive for site owners and operators and can render the site unsuitable for many land-uses and difficult to on-sell or lease to others.

Issue:	Contaminants from stockpiles of material awaiting processing or in stockpiles of finished product can leach into the soil. In addition, the operation of plant and equipment on site can give rise to spills or leaks of diesel, oils or lubricants which can be gradually deposited on-site and accumulate over time.
Desired outcome:	The building product recycling facility site should not become contaminated as a result of site operations.
Suggested measures:	• Site hard stand areas used for stockpiling or operations on sealed or compacted areas and graded to drain. • Water should not be allowed to pond on-site except in ponds designed for retention or infiltration. • All plant and equipment including hydraulic equipment should be regularly checked and maintained. • All fuels and hazardous goods should be properly stored in approved tanks or other structures as required by legislation. Storage facilities should meet AS1940:2004 Storage and Handling of Flammable and Combustible Liquids and Water Quality Protection Note 56 Tanks for Elevated Chemical Storage, Department of Water. • An emergency management plan that includes a spill incident plan should be prepared. A spill incident kit that includes a supply of absorbent material, interception devices and tools should be maintained on-site to enable an immediate and effective response to any spill. • Owners and operators of building product recycling sites may voluntarily undertake a contamination assessment to determine the existence of any site contamination and to establish a benchmark for future assessments. • Any known or suspected contamination must be reported to DEC, Contaminated Sites Branch.

Flora and fauna issues

The control of weeds, vermin and pest animals and the prevention of native plant disease is essential to maintaining the State's biodiversity by protecting native flora and fauna.

Issue:	Garden waste and timber in mixed loads may be contaminated with plant diseases and weed seeds that can spread from the stockpile or storage cells. Insects, such as the European House Borer, can be in timber from demolition sites. It is important not to spread these pests through distribution of recycled products.
Desired outcome:	Material stored on site does not contribute to the spread of weed seeds, plant diseases or encourage the breeding of any pest animals or insects.
Suggested measures:	• Acceptance criteria for construction and demolition waste should encourage the delivery of source-separated loads. • Wood in mixed loads should be readily isolated and inspected. • Wood and garden waste should be stored on a compacted or gravel hardstand pending transport or processing. • Buffer zones should be designed to complement existing vegetation indigenous to the local area. Consideration should be given to inter-connecting buffer areas with nearby bushland if appropriate to provide increased habitat for indigenous flora and fauna or corridors for the movement of native fauna. • Sound site design and appropriate plant species selection will reduce possible impact on surrounding flora and fauna. • The use of pesticides, herbicides or larvaecides such as used for mosquito control should be limited. Manufacturers' directions must be followed at all times.

Litter

The control and management of litter is essential to maintaining a compliant site. Litter could occur during the transportation of construction and demolition waste to the site as well as from the facility. All vehicles should be covered to prevent waste being blown onto the road or sand escaping through rear loading door. Larger items need to be well stacked and strapped to ensure they do not fall from the transport vehicle. This type of litter can be dangerous to following vehicles. The site should have a perimeter fence capable of capturing any wind-blown litter from escaping the facility compound. Regular litter collections should be undertaken around the facility.

Issue:	Wind-blown litter can be experienced from the facility which could end up on neighbouring properties or roadways. Littering could also occur from vehicles travelling to/from the facility.
Desired outcome:	No wind-blown litter escapes the facility or from vehicles travelling to/from the facility. No large items escape vehicles travelling to/from the facility.
Suggested measures:	• Perimeter fencing is erected around the facility to capture any wind-blown litter. • Regular litter collection program is established. • All vehicles leaving the facility should be covered to stop wind-blown rubbish falling from the vehicle. • All vehicles leaving the facility should have large items correctly stacked/strapped to stop falling from the vehicle.

Resource recovery

The objective of recycling facilities is to recover as much material for reuse/reprocessing as possible. The plant should be designed and operated in such a way as to maximise the economic manufacture of saleable product and minimise the amount of waste to landfill.

Issue:	Recycled construction and demolition waste can be used to replace quarried rock and sand for a wide variety of applications. Recycling reduces the requirement for new quarries and saves landfill space. Many applications have strict specifications, and therefore maintaining a consistent high quality of recycled product is important. There is also the potential that loads coming into the facility contain hazardous waste, such as asbestos, pesticides and heavy metals. Loads could also contain putrescible wastes.
Desired outcome:	The inherent resource value of construction and demolition waste is not wasted and no construction and demolition waste is stockpiled or stored in landfill that could otherwise be economically used for beneficial reuse, recycling or energy recovery.
Suggested measures:	• Install appropriate sorting equipment. • Ask customers to sort their waste at source to reduce contamination. Offer financial incentives, such as a lower gate fee for separated materials. • Reprocess products that do not meet specifications. • Implement a quality assurance system to maintain the quality of the final product. • Implement a quality control process that identifies and removes or rejects loads that contain hazardous materials.

Related legislation, regulations, licenses & guidelines as at May 2009

Department of Environment and Conservation
Environmental Protection Act 1986
Section 49 Causing pollution and unreasonable emissions.
Section 50A Causing serious environmental harm.
Section 50B Causing material environmental harm.
Section 70 Unreasonable noise emissions on premises.

Environmental Protection Regulations 1987 Schedule 1, Category 13
Licence required for crushing and screening operations in excess of 1,000 tonnes per annum.
Environmental Protection (Noise) Regulations 1997.
Environmental Protection (Unauthorised Discharges) Regulations 2004.
Environmental Protection (Clearing of Native Vegetation) Regulations 2004.
Landfill Waste Classification and Waste Definitions 1996 (as amended)

Waste & Resource Recovery Act 2007
Waste & Resource Recovery Regulations 2008
Waste & Recovery Resource Levy Act 2007
Waste & Resource Recovery Levy Regulations 2008

Contaminated Sites Act 2003
Contaminated Sites Regulations 2006.

Litter Act 1979
Litter Regulations 1981

Department of Mines and Petroleum
Dangerous Goods (Storage and Handling of Non-Explosives) Regulations 2007.
Dangerous Goods Safety Act 2004
Storage of Dangerous Goods: Code of Practice, draft for public comment, Department of Consumer and Employment Protection, March 2006.

Department of Water
Water Quality Protection Note 6, Vegetation buffers to sensitive water resources, February 2006
Water Quality Protection Note 44, Mechanical equipment washdown, March 2006
Water Quality Protection Note 52, Stormwater management at industrial sites, July 2006
Water Quality Protection Note 56, Tanks for elevated chemical storage, April 2006
Water Quality Protection Note 68, Roads near sensitive water resources, February 2006

Department of Health
Health (Asbestos) Regulations 1992
Draft Public Health Bill 2008, Part 6 Public Health Plans and Part 7 Public Health Assessments

Fire and Emergency Services Western Australia
Fire Brigades Act 1942 Section 25 & Section 33

Standards Australia
AS1940:2004 The Storage and Handling of Flammable and Combustible Liquids

REFERENCE 4

CEMENT

Introduction

Cement is one of the most widely used construction materials. Anyone who uses cement (or mixtures containing it eg mortar and concrete) or is responsible for managing or supervising its use should be aware that it may be a hazard to health and that safe working practices must be used to minimise the risk. This sheet advises on how to use cement safely.

The most commonly used cement contains mainly calcium silicate with aluminium and iron compounds together with a small amount of gypsum. High-alumina cement contains calcium aluminates. A variety of additives such as alkaline hardeners may be used to produce special-purpose cements and these increase the risk of dermatitis.

Health effects

Cement can cause ill health mainly by:

Skin contact: contact with wet cement can cause both burns and dermatitis:

1) Cement burns: if freshly mixed concrete or mortar gets trapped against the skin, eg by falling inside a worker's boots for gloves, serious skin burns or ulcers can result which can take several months to heal and may need skin grafting;

2) Dermatitis: skin affected with dermatitis feels itchy and sore and looks red, scaly and cracked. Two sorts of dermatitis can occur:

   a) **Irritant** dermatitis results from direct damage to the skin caused by the combination of wetness, chemical corrosiveness and abrasiveness of cement in concrete and mortar:

   b) **Allergic** dermatitis results when workers become sensitised to chromium salts which may be present in the raw materials used to make cement. Sensitisation to additives such as pigments, epoxy resins and hardeners can also occur.

Eye contact: contact with cement powder or wet cement can cause irritation and inflammation.

Inhalation of dust: high levels of dust can be produced when cement is handled, for example when emptying bags of cement or during their disposal. In the short term, exposure to high levels of cement dust irritates the nose and throat and causes difficulty with breathing. There is uncertainty about the long term health effects of breathing in cement dust; chronic chest trouble is possible.

Abrading hardened concrete eg in scabbling or concrete cutting, can give rise to large amounts of inhalable dust which could contain high levels of silica, depending on the aggregate that has been used. Workers breathing in silica dust are at an increased risk of developing chest complaints.

Musculoskeletal risk: working with cement also poses less obvious risks such as sprains and strains particularly to the back, arms and shoulders from, for example, lifting and carrying bags of cement, mixing mortar, etc. there is also a risk of more serious damage to the back from the cumulative effects of long-term involvement with these activities, particularly the manual handling of cement bags weighing up to 50 kg.

Legal provisions

Work with cement is subject to the Control of Substances Hazardous to Health Regulations 1994 (COSHH) which requires the health risk to be assessed and then prevented or controlled. Users should get information on risks and precautions from manufacturers/suppliers who have a legal duty to supply it.

Manual handling activities are subject to the Manual Handling Operations Regulations 1992. These require employers and the self-employed to avoid manual handling activities where practicable. If the manual handling activity cannot be avoided, then the risks must be assessed and reduced so far as is reasonably practicable.

Precautionary measures

Preventing dust exposure.

Work in a way which avoids dusty methods of work. For example, scabbling is often carried out to ensure an adequate bond between successive concrete pours and the amount of scabbling can be reduced by larger pours. The need to cut or break hardened concrete can be reduced by designing work so as to allow for tolerances, by not relying on perfect fit nor on cutting away to make things fit, by leaving positive gaps and specifying expanding grout, mastic or resilient materials as joint fillers.

Controlling dust exposure

Work in a way which minimises the amount of dust produced. So, open bags of cement with care, mix carefully etc. Handle dry material in a well-ventilated area.

Personal protection

Workers must be provided with and wear clothing to protect their skin from cement and cement mixtures, eg

- Gloves
- Overalls with long sleeves and full-length trousers
- Waterproof boots

Clothing should be worn so as to avoid 'traps' for fresh mortar or concrete to fall in ie with sleeves over the gloves and trouser legs over the boots – not tucked inside. If 'trapping' does happen, steps should be taken **immediately** to clean the contaminated skin and protective clothing with copious amounts of clean water.

Suitable respiratory protective equipment should be work if dusty conditions cannot be avoided.

Suitable eye protection must be worn when conditions give rise to a risk of eye injury (eg opening cement sacks, during mixing where splashing might occur).

Manual handling

The manual handling of cement bags presents a risk of musculoskeletal injury, where possible employers and the self-employed should:

- Plan the work to remove the need for bags to be moved more than once (eg cement bags can be delivered straight to a mixing area)
- Consider mechanical handling assistance
- Specify and use lower weight bags (eg 25 kg size)

Where the manual handling of cement bags is unavoidable, employers and the self-employed must carry out a suitable and sufficient risk assessment that should consider the task, load, working environment and individual capability. This does not mean every job involving manual handling has to be look at in detail. If the load is 25 kg, easily gripped close to the body and the working conditions are good, the risk of injury to most working people will be low and no further assessment will be needed.

Where the load is heavier than 25 kg, or handling involves twisting or lowering there may be more chance of injury and the assessment will need to be more detailed.

Hygiene

Personal hygiene is important. Adequate welfare facilities should be available on site and workers should wash their hands and face at the end of a job and before eating, drinking or smoking, and wash their hands before using the toilet. Facilities for cleaning boots and changing clothes should also be available.

First aid

Contaminated skin should be washed with cold running water as soon as possible. Particular attention should be paid to any wound which should be covered with a suitable dressing. Eye contamination should be washed with cold tap water for at least 10 minutes before the affected person is taken to hospital.

REFERENCE 5

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Full Length Research Article

The Effect of Chronic Cement Dust Exposure on Lung Function of Cement Factory Workers in Sokoto, Nigeria

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ABSTRACT
The present study was designed to investigate the effect of cement dust exposure on lung function in Nigerians because of paucity of such data. Lung function tests were carried out on 56 cement factory workers with mean years of exposure to cement dust of 10.2±5.6 years and on 96 non exposed subjects. The vital capacity (3.7 ± 0.5; versus 4.1 ± 0.5L; P<0.001) and forced expiratory volume in one second percent (FEV_1%; 78.4 ± 13.8; versus 89.0 ± 6.9; P<0.005) were significantly lower in cement factory workers than in control subjects. However, forced vital capacity (3.9 ± 0.1 versus 4.0 ± 0.1L) and Peak Expiratory Flow Rate (PEFR; 497.0 ± 14.0 versus 527 ± 15.0 L/min) showed no significant difference. These results suggest that chronic cement dust exposure impairs lung function. Since protective gears were available, these findings suggest that either compliance to their use was poor or they were ineffective. It is recommended that the cement factory management embark on health education, acquire effective protective gadgets and enforce their usage. Also there should be containment of dust emission by use of dust filters.
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Keywords: *Lung function, Cement dust, exposure, Sokoto, Nigeria*

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INTRODUCTION

Cement production is invariably a dusty operation resulting in the exposure of factory workers to cement dust. Although protective gears should be worn, reports from third world countries indicate that industries rarely provide precautionary measures (Al-Neaimi et al, 2001; Azah et al, 2002). The resulting exposure to cement dust has led to impairment of respiration and a prevalence of respiratory symptoms amongst workers (Alakija et al, 1990; Al-Neaimi et al, 2001; Meo et al, 2002) culminating in what has been described as a "Cement factory lung disease" (Alakija et al, 1990). The severity of the impairment of respiratory function has been shown to depend on years of exposure (Alakija et al, 1990).

However there are reports that contradict this notion (Vestbo and Rasmussen, 1990; Yang et al, 1993; Fell et al, 2003). These reports suggest that cement dust exposure may neither increase the morbidity of respiratory diseases (Vestbo and Rasmussen, 1990; Fell et al, 2003) nor be associated with the prevalence of respiratory symptoms among workers (Yang et al, 1993; Fell et al, 2003).

The parameters used to assess respiratory function in these studies include vital capacity, FEV_1 (Forced expiratory volume in 1 second) $FEV_1\%$ (Forced expiratory volume in 1 second as a percentage of forced vital capacity), and PEFR (Peak expiratory flow rate) (Alakija et al, 1990; Al-Neaimi et al, 2001; Meo et al, 2002). There are few reports on the effect of cement dust exposure in cement factory workers in Nigeria. To our knowledge only one study has addressed this problem at the Cement factory, Okpella, Edo State (Alakija et al, 1990). A related work on the effect of granite dust exposure on lung function of children schooling near the Crushed rock industry, Akamkpa, Cross River State has also been reported (Azah et al, 2002). In this report we have studied lung function in cement factory workers in Sokoto. This study was embarked upon in view of the controversy concerning the effect of cement dust exposure on lung function and the paucity of such data in Nigeria.

MATERIALS AND METHODS

The study population comprised those working in the cranes, packing, crusher and mill sections of the factory. The workers in these sections were selected because of their high level of exposure (Alakija et al, 1990; Mwaiselage et al, 2005). All the 56 eligible workers of the total number of 70, working in these sections were enrolled in the study. They had been exposed to cement dust for a period of 10.2 ± 5.6 (mean $\pm$ SEM) years. An unexposed (control) group consisted of 96 blue-collar workers who belonged to the same socio-economic class as the exposed group, and working and residing 20 kilometers away from the cement factory in the Sokoto metropolis. Only subjects who were non smokers and who had no history or signs of chronic cough, bronchitis, bronchial asthma or other signs and symptoms suggestive of respiratory diseases were eligible and selected into both the exposed and unexposed groups.

Data collection was effected by way of an interviewer-administered structured questionnaire, to determine the socio-demographic characteristics, years of exposure as deduced from date of employment, site or position at workplace, use of safety gadgets such as dust masks, earplugs, hand gloves, safety boots, goggles and work overalls. Information on general health, history of past disease(s) and habits such as smoking and alcohol consumption were obtained.

The heights (cm) of the subjects were measured without shoes. Weight (kg) was measured with minimum clothing using a bathroom scale. Lung function tests were carried out with a vitalograph spirometer (Vitalograph Ltd, Buckingham, UK) and a Wright peak flow meter (Airmed, UK). The procedures were carefully explained and demonstrated to each subject and then the tests were carried out. Each anthropometric or lung function parameter was measured by a trained technician familiar with the procedure. The use of one observer per measurement was maintained throughout the study. The leader of the team randomly repeated some of the measurements to validate their accuracy.

Vital capacity, forced vital capacity, forced expiratory volume in 1 second, and forced expiratory volume in 1 second percent (as a percentage of forced vital capacity) were measured using a vitalograph spirometer. The recording was done with each subject standing, without nose clips and with the lips firmly applied around the disposable mouthpiece. The subject inspired maximally and then expired as forcefully and rapidly as possible into the vitalograph. Three attempts were made and the best of the three spirogram was selected (Afolabi et al, 1996; Al-Neaimi et al, 2001). The value of VC, FVC, and FEV_1 was read off the selected spirogram.

The Peak expiratory flow rate [PEFR], was measured with the subject standing, without nose clips and with lips firmly applied around the disposable mouthpiece. The subject inspired maximally and then expired as forcefully and rapidly into the peak flow meter as possible. The best of three readings was taken (Afolabi et al, 1996; Al-Neaimi et al, 2001).

All the lung function parameters were measured at ATPS (ambient temperature and pressure saturated with water vapour). The relationship between vital capacity and years of service at employment was subjected to correlation analysis and a regression equation defining the relationship was derived.

It is well known that anthropometric parameters such as age, sex, height, weight and ethnicity affect lung function (Onadeko et al, 1984; Jaja, 1989; Njoku and Anah, 1999). Attempts were therefore made to match the exposed subjects with the unexposed subjects *ab initio*. However this was not very successful and so this comparison was designated "Subjects unmatched". To fully achieve matching a subset of subjects from each group (n=20) that matched very well in terms of age, sex, height, weight and ethnicity were selected and this comparison was designated "Subjects matched".

Results are expressed as mean ± standard error of mean (SEM). Statistical analysis was carried out using the unpaired student t test.

RESULTS

Table 1 gives a summary of the anthropometric parameters of the exposed and unexposed subjects when they were unmatched and when matched. In the unmatched category, comparison of the anthropometric parameters of the exposed with the unexposed group was similar except in their weights.

Table1. Anthropometric parameters and length of service of workers exposed to cement dust and those unexposed (NS=not significant)

Parameter	Subjects Unmatched			Subjects Matched		
	Exposed (Mean ± SEM)	Unexposed (Mean ± SEM)	P value	Exposed (Mean± SEM)	Unexposed (Mean ± SEM)	P value
Age [years]	36.1± 1.7	37.0 ± 0.8	NS	33.5± 1.0	34.0 ± 1.0	NS
Weight [kg]	67.2± 2.8	61.0 ± 0.9	<0.001	60.6± 1.4	60.4 ± 1.2	NS
Height [cm]	173.7± 3.3	174.0± 0.6	NS	171.8±1.6	172.5 ± 1.0	NS
N	56	96		20	20	

Table 2: Lung function parameters of workers exposed to cement dust and those unexposed.

PARAMETER	Subjects Unmatched			Subjects Matched		
	Exposed [Mean± SEM]	Unexposed (Mean±SEM)	P-value	Exposed (mean± SEM)	Unexposed (mean± SEM)	P-value
Vital capacity [L]	3.8± 0.09	3.8 ± 0.07	NS	3.7 ± 0.1	4.1 ± 0.5	<0.001
FVC [L]	4.0 ± 0.09	3.8 ± 0.09	NS	3.9 ± 0.1	4.0 ± 0.1	NS
FEV_1%	78.8 ± 1.8	81.4 ± 1.6	NS	78.4±3.1	89.0 ± 1.5	<0.005
PEFR [l/min]	517.1± 10.5	521.4 ± 8.5	NS	497.0 ± 14.0	527 ± 15.0	NS
N	56	96		20	20	

The exposed group was significantly heavier than the unexposed ($P<0.001$). When the subjects were fully matched the anthropometric parameters of both groups were identical.

The lung function parameters are presented in table 2. These parameters did not differ significantly between the exposed and unexposed groups when the subjects were unmatched. Following the matching of the subjects, the vital capacity ($P<0.001$) and $FEV_1\%$ ($P<0.005$) fell significantly in the exposed group compared to the unexposed while the forced vital capacity and the peak expiratory flow rate (PEFR) did not differ significantly.

DISCUSSION

The major finding of this work is that the lung function parameters, vital capacity and $FEV_1\%$, were significantly lower in workers exposed to cement dust compared to those unexposed. This suggests that chronic cement dust exposure impairs lung function. It agrees with the findings of Alakija et al (1990) who first reported "Cement factory lung disease" in Nigeria and those of others elsewhere (Al-Neaimi et al, 2001; Meo et al, 2002). However the forced vital capacity (FVC) and PEFR did not differ significantly in the exposed group compared to the unexposed. This underscores the importance of using several indices of lung function in comparative studies such as this.

However, the present findings do not support the notion that chronic cement dust exposure does not impair lung function as reported by some workers (Vestbo and Rasmussen, 1990; Yang et al, 1993; Fell et al, 2003). In this study, responses from the questionnaires and interview of the workers indicate that protective measures were provided and that they were used. Thus the observed impaired lung function may be due to the ineffectiveness of the protective gears. However non compliance of the workers in the use of protective gears cannot be ruled out in spite of contrary questionnaire and interview responses. Thus, lung function tests may be useful in assessing the effectiveness of preventive measures such as the wearing of dust masks or compliance by workers to preventive measures. Unlike previous reports which indicate the non provision of protective gears in cement (Al-Neaimi et al, 2001) and related factories (Azah et al, 2002) in the developing world, the findings of the present study indicate they were provided.

The lung function parameters showed no significant difference between the exposed and unexposed groups when the subjects were unmatched. This may be due to the fact that the exposed group was significantly heavier than the unexposed although they remained similar in terms of age and height (table 1). When complete matching using weight, age and height was done, the lung function parameters (Vital capacity and $FEV_1\%$) became less in the exposed group compared to the unexposed and the effect of cement dust exposure became apparent. This underscores the importance of matching subjects using anthropometric parameters in lung function studies. It also confirms the well known effect of anthropometric parameters on lung function (Onadeko et al, 1984; Jaja, 1989; Njoku and Anah, 1999). The impairment of lung function observed in the exposed group may not be due to socio-economic factors as both groups came from the same socio-economic class.

The findings of various workers on the various lung function parameters however have varied. For instance, in the work of Alakija et al (1990) FEV_1 and PEFR were significantly lower in cement factory workers than in the control group. Also Azah and colleagues (2002) found FVC, FEV_1 and PEFR to be lower in granite dust exposed subjects than in the control group but $FEV_1\%$ remained unchanged. In the present study, vital capacity and $FEV_1\%$ were significantly lower in the cement factory workers than in the unexposed (control) group while the FVC and PEFR remained similar.

The results of the present study suggest that chronic exposure to cement dust has deleterious effect on the lungs. However the exact mechanism (s) by which it does this is unknown. For instance it is yet to be determined whether these effects are due directly to cement dust or mediated by a metabolic product of cement dust. It will be interesting to further investigate this. However it has been suggested that the reduced $FEV_1\%$ in cement factory workers may be due to reflex bronchospasm triggered by inhaled irritant cement dust or as a result of type 1 hypersensitivity reaction (Alakija et al, 1990). Indeed the components of cement dust show irritating, sensitizing and pneumoconiotic properties (Maviejewska and Bielichowska-Cybula, 1991). Animal studies reveal that cement dust induces atrophic and hypertrophic changes in the nasal and pharyngeal mucosa as well as chronic exfoliative bronchitis (Maviejewska and Bielichowska-Cybula, 1991). Post mortem examination of the lungs of experimental animals exposed to cement dust revealed slight tissue fibrosis and some emphysema foci (Maviejewska and Bielichowska-Cybula, 1991). Also a report suggests that cement dust exposure may decrease lung and thoracic compliance by impairing intercostal muscle performance (Meo et al, 2002). These effects of cement dust may account for the observed impairment of lung function observed in this study.

In summary, the present results show that the vital capacity and $FEV_1\%$ were significantly reduced in workers exposed to cement dust relative to the unexposed control. However FVC and PEFR remained similar in both groups. These results suggest that chronic exposure to cement dust impairs lung function. Since protective gears were provided, the impaired lung function suggests that the gears were either ineffective or the workers did not use them. It is concluded that chronic exposure to cement dust has adverse effect on lung function. We recommend that to safeguard the health of workers and the host community the cement factory management embark on safety training in work environment and conduct health education on hazards of exposure to cement dust, safety precautions and practices. They should acquire effective protective gadgets and ensure compliance with their usage. Also there should be regular/periodic monitoring of cement dust level in and around the factory environment, and containment of dust emission by the use of dust filters.

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IMPACT OF DUST EMISSION ON PLANT VEGETATION IN THE VICINITY OF CEMENT PLANT

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Abstract

Environment is a major issue which confronts industry and business in today's world on daily basis. Different industrial activities are degrading various environmental components like water, air, soil and plant vegetation. Cement industry is one of the 17 most polluting industries listed by the Central Pollution Control Board (CPCB). The Jaypee Rewa Cement Cement industry, Rewa, Madhaya Pradesh is located between $24^\circ\ 33'$ North longitude and $81^\circ\ 10'$ east latitude and is situated at Jay Prakash Nagar 20 km from Rewa Town of Madhya Pradesh, India. The Jaypee Rewa Cement industry is the major source of particulate matters, SOx, NOx and CO_2 emissions. Cement dust contains heavy metals like nickel, cobalt, lead, chromium, pollutants hazardous to the biotic environment, with impact for vegetation, human and animal health and ecosystems. Present paper attempts to focus on impact of cement emission on plant vegetation.

Key words: cement industry, environmental impact assessment, environmental problem, dust pollution

1. Introduction

Diverse industrial activities are degrading various environmental components like water, air, soil and plant vegetation. The environmental pollution as a result of cement industry could be defined as the adverse impact induced for water, air and land through various activities, starting from mining activity of the raw material (lime stone, dolomite etc.) up to its crushing, grinding, and other processes developing in a cement plant. Cement industry is one of the 17 most polluting industries listed by the Central Pollution Control Board (CPCB).

The extensive extraction of raw material not only adds various pollutants/contaminants to the environment but also disturb the total ecosystem of the area. The gases and dust from the cement plant are in no way less hazardous compared to other industries. Cement kiln dust is proven to have cytogenetic and mutagenetic properties (Shivkumar et al., 1995). Dispersion pattern of suspended particulate matter in ambient air of electrostatic precipitator (ESP) of cement plants and calcification of surface soil in the vicinity of the cement plant have been reported by earlier workers (Banrjee et al., 1986; Banrjee et al., 1987).

2. Study area

The Jaypee Rewa Cement, Rewa, Madhaya Pradesh was selected for the present study. It is one of the biggest cement factories of India. The J.P. Cement industry is located between $24^\circ\ 33'$ north longitude and $81^\circ\ 10'$ east latitude and is situated at Jay Prakash Nagar 20 km from Rewa Town. Eight villages were chosen for present study, located in different directions and distances from the plant, as given in Table 1 (Shukla et al., 2003).

Naubasta village is nearest to Jaypee Rewa Cement (JRC) plant. The total area of the village is 532.67 hectares and the population is 4000 on the basis of the 2001 survey. The movements of mine

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vehicles have a great impact on this village as it falls on the way from JRC plant to Naubasta mines.

Chhijwar is on the south of JRC plant about one km distance, with 495.29 hectare area. Population of this village is 4315. The mining of limestone is carried out in this village.

Gadwa is located about 2 km on north of JRC plant. It has 518 hectare area and 4600 population. The lime stone mining is the major activity.

Kachur is situated in the north east direction of JRC plant located at a distance of 3 km. Total land of this village is 679.67 hectare and population is 3000.

Tiwani is located at a distance of 3 km on the south east direction. It has 473.62 hectare land and 2032 individuals.

Sagouni is nearer to Tiwani at a distance of 3 km in the south-east direction.

Maddhepur is located at a distance of 5 km on the south west direction, with 599.26 hectare total area and 2200 population.

Turki is located at a distance of 5 km. on the west direction of JRC plant. The total area of this village is 521.82 hectare and total 3000 individuals live in this village.

3. Material and method

3.1. Impact assessment on plant vegetation

An attempt has been made to record the impact of emissions from cement industry on vegetation. Five plant species were selected i.e. *Madhuca indica, Ficus religeosa, Azadirechta indica, Eucalyptus globulus* and *Mangifera indica* in an area of five kilometers surroundings of cement plant and experiments were conducted as is described below (Carlson et al., 1996; Chang et al., 1999).

3.2 Dust load estimation

In order to estimate the dust load, 25 leaves from different branches of selected tree species have been collected and kept in separate polythene bags. In the laboratory, the leaves from each polythene bags were washed. The water containing dust had been filtered through pre-weighed filter paper. The filter papers were dried in the oven over night and weighed again. The difference in the weight of filter paper yielded the amount of dust on the sampled leaves. The leaves surface area was calculated. From this data, dust load per cm^2 of leaf was calculated (Carlson et al., 1996; Chang et al,. 1999).

3.3. Chlorosis and necrosis

Chlorosis is the phenomenon of leaves yellowing due to the loss of chlorophyll. Necrosis means the wilting of leaves due to the lack of chlorophyll. Chlorosis and necrosis occur due to exposure to pollutants like SOx, NOx etc. For measuring the extent of chlorotic effects, 200 leaves were collected at different heights and the percentages of leaves exhibiting chlorosis and necrosis were calculated (Carlson et al., 1996; Chang et al., 1999).

4. Result and discussion

Table 2 and Fig. 1 reveal that the dust load was maximum on all types of plants sampled Gadwa, located at 2 km on the north side, followed by Naubasta (East) and Kachur situated 3 km away on North-East side. The maximum deposition per cm^2 was on *Azadirechta indica*, followed by *Eucalyptus globulus*. The smallest amount of deposition was found on *Ficus religeosa.* The dust load study revealed that a small amount of dust was deposited in Maddhepur and Turki located 5 km away on south-west and west direction respectively. Prevalent wind flow direction was also north and north-east direction. *Azadirechta indica* and *Eucalyptus globulus* showed a high dust holding capacity followed by *Madhuca indica*, while *Mangifera indica* and *Ficus religeosa* showed a small dust holding capacity.

Table 3 shows the data on leaves suffered from necrosis/chlorosis of all five tested plants. It was found that the highest values resulted in Kachur, situated 3 km in north-east direction and Naubasta, in north direction. This was followed by Sagouni (SE) and Gadwa (North). The smallest number of leaves suffering of necrosis/chlorosis was found in Turki (West) and Maddhepur (SW) (Fig. 2). *Mangifera indica* and *Azadirechta indica* were affected the most, while *Madhuca indica* and *Eucalyptus globulus* were affected least plant species from chlorosis and necrosis.

Table 1. Details of villages studied

No. of site	*Village name*	*Direction with respect to industry*	*Distance with respect to industry (km)*	*Area (hectares)*	*Population*
1.	Naubasta	East	0	532.67	4000
2.	Chhijwar	South	1	495.29	4315
3.	Gadwa	North	2	518	4600
4.	Kachur	North- East	3	679.67	3000
5.	Tiwani	South- East	3	473.62	2032
6.	Sagouni	South-East	3	332.54	3210
7.	Maddhepur	South-West	5	599.26	2200
8.	Turki	West	5	521.82	3000

Table 2. Dust load on plant species

Site number	*Plants in Village*	*Distance and direction*	*Dust load of 25 leaves (mg)*	*Dust load per leaf (mg)*	*Dust load mg/cm²*
1.	**Naubasta**	0 km			
	Mangifera indica		600	24	0.4
	Ficus religeosa		165	6.6	0.62
	Eucalyptus globulus		900	36	1.9
	Azadirechta indica		1350	54	0.87
	Maduca indica		1880	75.2	0.87
2.	**Kachur**	3 km NE			
	Mangifera indica		556	22.6	0.42
	Ficus religeosa		119	7.6	0.15
	Eucalyptus globulus		780	31.2	1.32
	Azadirechta indica		1225	49	1.48
	Maduca indica		625	25	0.28
3.	**Tiwani**	3 km SE			
	Mangifera indica		600	24	0.43
	Ficus religeosa		500	20	0.33
	Eucalyptus globulus		400	16	0.66
	Azadirechta indica		600	24	0.81
	Maduca indica		500	20	0.91
4.	**Sagouni**	3 km SE			
	Mangifera indica		525	21	0.45
	Ficus religeosa		400	16	0.30
	Eucalyptus globulus		175	7	0.19
	Azadirechta indica		475	19	0.63
	Maduca indica		365	14.6	0.130
5.	**Maddhepur**	5 km SW			
	Mangifera indica		255	10.2	0.24
	Ficus religeosa		225	9	0.15
	Eucalyptus globulus		2510	100.4	0.21
	Azadirechta indica		125	5	0.18
	Maduca indica		575	23	0.23
6.	**Turki**	5 km West			
	Mangifera indica		330	13.2	0.30
	Ficus religeosa		210	8.4	0.14
	Eucalyptus globulus		215	8.6	0.17
	Azadirechta indica		90	3.6	0.13
	Maduca indica		457	19	0.18
7.	**Gadwa**	2 km North			
	Mangifera indica		125	21	0.05
	Ficus religeosa		150	6	0.09
	Eucalyptus globulus		860	34.4	1.25
	Azadirechta indica		1295	51.8	2.46
	Maduca indica		800	32	0.48
8.	**Chhijwar**	1 km South			
	Mangifera indica		550	22	0.42
	Ficus religeosa		110	4.4	0.52
	Eucalyptus globulus		100	4	0.136
	Azadirechta indica		850	34	0.22
	Maduca indica		4100	164	1.63

Table 3. Necrosis/chlorosis on plant species

Site number	*Village*	*Distance and direction*	*% of leaves suffered necrosis/chlorosis*				
			Madhuca indica	*Mangifera indica*	*Azadirechta indica*	*Ficus religeosa*	*Eucalyptus globulus*
1.	Naubasta	0, East	6	60	42	37	5
2.	Chhijwar	1, South	3	14	24	13	3
3.	Gadwa	2, North	5	42	43	39	5
4.	Kachur	3, North- East	20	60	60	46	19
5.	Tiwani	3, South- East	2	14	38	6	2
6.	Sagouni	3, South-East	9	58	55	37	9
7.	Maddhepur	5, South-West	4	6	8	3	3
8.	Turki	5, West	NA	NA	NA	NA	NA

NA = Not affected

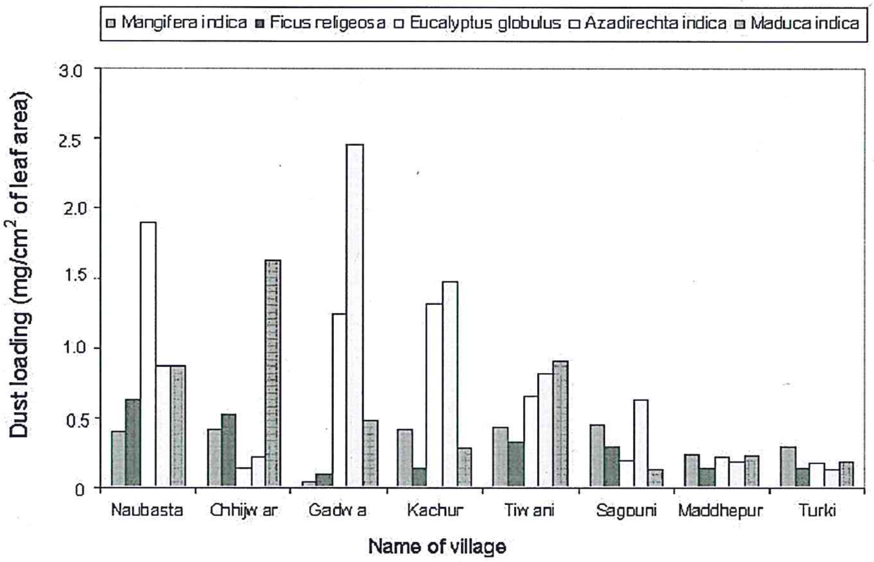

Fig. 1. Variation in dust load in various plant species in different villages

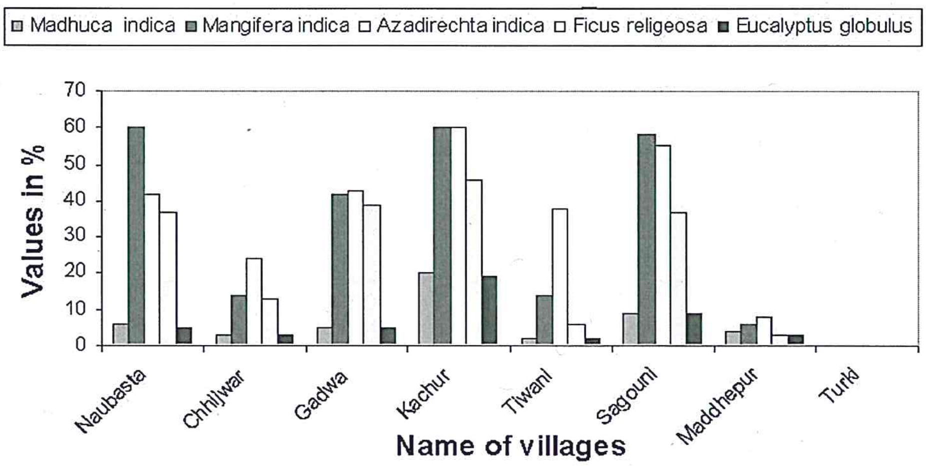

Fig. 2. Leaves suffering of necrosis/chlorosis in different villages

5. Conclusions

The research presented in this work revealed that the cement industry is one of the highly polluting industry, the major impact being confined to air environment. Control SPM and other emissions should be given top priority to maintain the ecosystem around the unit in its natural or near to natural form.

Proper maintenance on the various process equipment and machine efficiency ensure reduction in the generation of dust and gases during various operations. This would reduce adverse impact on vegetation and human life. Adequate green belt should be developed in the plant area and in the village vicinity in order to restrict spreading of dust.

Cement industry faces a lot of problems due to mining activity. To overcome this problem, they should start back-filling of abandoned mine as soon as they complete the mining of a particular area. Dense plantations should also be done to prevent the soil erosion and silting problem of Kariyari River. It was also found in above study that *Azadirechta indica* and *Eucalyptus globulus* were the species which showed high dust holding capacity followed by *Madhuca indica*. Also *Madhuca indica* and *Eucalyptus globulus* were least affected plant species from chlorosis and necrosis. So *Eucalyptus globulus* and *Madhuca indica* may be very significant for using as green belt surroundings of cement industry.

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