Guidance to Prevent Hot Meal Burns

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1. Scope of this guidance

This document focuses on the hazards and associated risks of working in dry process pre-heater towers and on the areas under/around grate or cross bar cooling systems; posed by hot meal (the mixture of raw feed materials used in cement manufacture). Consequently, procedures for clearing and hot working in pre-heater towers systems and coolers, should be modified to take account of its recommendations. Only the tasks, which involve exposure to hot meal where there is the potential for personal injury, have been evaluated.

Further recommendations are made to establish better control over hot meal and reduce the risk of hot meal incidents. This guidance is intended for use at UK cement kilns.

Hot meal in kiln

2. Hazards and Risks

Hazards are caused by blockages and accidental releases of hot cement meal at temperatures that may be up to 900^{o}C or more. The hot meal can flow like a liquid and consequently escape through any unsealed parts of the clinker manufacturing environment.

Risks occur when employees are exposed to hot meal, typically during unblocking, maintenance and cleaning activities. Incidents involving hot meal burns have caused death and injury in the cement industry as some of the following reports demonstrate.

Incident 1

Three employees were in the process of repairing an air leak around an external access door on a cement kiln. Two of them were on a scaffold and had removed the access door of the kiln to replace the seal. A blockage in the pre-heater broke loose sending 900 degree centigrade material into the kiln and out the access door opening.

The hot material knocked one of the victims off the scaffold. He fell 25 feet landing face down in hot material that had accumulated on the ground and died instantly from sustained injuries. Another employee suffered third degree burns over 90 per cent of his body and died two weeks later. The third employee suffered third degree burns to his feet.

Incident 2

A process operator with 29 years experience was seriously injured when clearing a blockage inside a cement clinker drag conveyor located in a tunnel.

Fatal accident site

When the access door for the enclosed conveyor was opened, hot clinker spilled into standing water generating a steam outburst that burned the victim. The victim died from his injuries a week later.

Incident 3

A team of workers were freeing a jammed drag chain that removed dust from a filter. A hatch in the kiln was opened to remove a build-up of dust which was believed to be causing the problem.

This filled the building with very hot dust although no one was hurt at that stage. When the dust had cleared, it was assumed that it had all come out but a further dust fall occurred as the hatch was being replaced.

One employee was burned on his face, neck, ear, chest and hand and also suffered scratches to the surface of his eyes. Another employee was burned on the face, neck and ear.

Incident 4

During a routine inspection a cap became detached from a maintenance point, causing hot raw material to spill out onto the second floor of the pre-heater tower. The spillage was mainly contained within the pre-heater tower, but as a precaution, because of the presence of oxy-acetylene canisters in the area, the fire brigade was called to the site.

3. Reducing Personnel Exposure

The Management of Health and Safety at Work Regulations 1999 include duties on employers to assess risks and where necessary take action to safeguard health and safety. The regulations require employers to carry out a suitable and sufficient assessment of the risks for all work activities for the purpose of deciding what measures are necessary for safety. A hierarchy of control measures is set out that has legal status.

Local/task specific risk assessments should be the norm in addition to area specific risk assessments. It is important that the recommendations made in this document are considered as part of the overall risk assessment. This will allow any health and safety conflicts that might arise from the recommendations, e.g. because of a higher priority risk, to be resolved at the local level.

Ultimately companies and sites are responsible for the nature and scope of the controls that need to be implemented based on their health and safety policy and in particular the site specific risk assessment.

If the requirement for personnel to be exposed to hot meal is removed, then the risk of injury from hot meal is largely removed. Personnel exposure to hot meal during normal operations of the kiln system is negligible; physical and managerial control measures should be in place that prevent direct contact between operators and the internal heat of the kiln systems. Provided these control measures are adhered to, the probability of injury is very low. The main priorities should be to prevent blockages occurring in the first place and to reduce the size of blockages by early detection.

It is only in response to particular circumstances that personal exposure to the hot environment will be required. It is under these conditions where the potential for injury is greatest. There are usually two reasons for personnel exposure to the internal heat of the pre-heater tower:

- Breakdown or blockage
- Normal cleaning / coating removal

During breakdown or blockage and normal cleaning activities, personal exposure to hot meal may sometimes be unavoidable. However, this exposure should be for the shortest duration possible, to a minimum number of personnel (but always more then one) and at the lowest temperature possible.

The risks associated with clearing blockages should be reduced by

- Automatic clearing systems
- Risk assessment
- Proper management systems,
- Safe working procedures, such as permits to work.
- Effective supervision
- Trained and competent personnel
- Good communications
- The use of *"Suitable & Approved"* Personal Protective Equipment

Kiln Feed Chemistry

The cement process is particularly prone to the formation of build-ups in the pre-heater where the kiln feed contains relatively high levels of sulphur and low levels of alkalis.

The raw meal passing into the kiln as kiln feed and the fuel fired in the kiln contain some compounds which volatilise or dissociate when they encounter the high temperatures in the kiln burning zone.

In this state these compounds travel back up the kiln system with the kiln exhaust gases until they reach a part of the kiln or pre-heater system where the temperature is below the melting point of the compound. At this point they will condense and form a strong glue, which can bind meal together and form build-up.

In order to minimise build-up in the kiln and pre-heater it is therefore important to minimise the burning zone temperature. The burning zone temperature will largely be determined by how easy it is to "burn" the kiln feed mix to achieve the

target free-lime level. The ease of burning of kiln feed is determined by its chemical composition and fineness which determines the "combinability"; the ability of the kiln feed to be combined into the clinker minerals.

Key kiln feed chemistry features to control pre-heater build-up include:

- Minimising the combinability temperature of the kiln feed by tightly controlling kiln feed chemistry and raw mill product residues on target.
- Ensuring that there is sufficient oxygen in the kiln to eliminate spikes at the kiln inlet and pre-heater exit. Typically, this means that the kiln exit oxygen concentration should be maintained at between 3 and 4% V/V (volume of oxygen as % of total volume).
- Setting up appropriate communication systems that inform other process staff of any increased risk of blockages.

Reducing Cyclone Blockages

Reliable methods of monitoring flow through the pre-heater tower cyclone system represent best practice. Accurate diagnosis of a failure in a cyclone outlet can prevent large build-ups of material in the blocked cyclone. This may be achieved by alerting the kiln controller to the problem (e.g. by sounding an alarm) or by automated removal of the kiln feed.

Reducing the amount of hot meal within a blocked system reduces the volume of material personnel are exposed to if internal intervention is required. Reduced volume also has the advantage of generally reducing the overall exposure time and furthermore it can reduce the time the precalciner is shut down to allow unblocking.

Suitable nucleic, isotopic probes or similar devices that provide real time flow indication and early blockage reporting should be installed on all cyclonic towers.

Alarm Systems & Automatic Shut Off

Normal system operating conditions should be established sufficiently to allow key alarm parameters to be set for hot meal blockages. When these parameters are reached, audible and visual alarms should sound in all vulnerable areas such as coolers, clinker transport and pre-heater or cooler sample points to warn personnel.

Where control systems allow, a kiln feed control loop should be established that

- operates the alarms detailed above
- shuts off the kiln feed system

should a number of pre-determined parameters be reached.

Static Cleaning Systems

Static cleaning systems fitted on UK cement works, generally come in two types:

- A fitted 'blaster' or 'air cannon' type system. Fitted to a known and identified point within the system that attracts build-ups. Most can be discharged manually and some are discharged by an automatic system, the timing of which is set as result of experience.
- A movable system (e.g. Cardox^{TM}), which can be fitted, used and then removed.

Both of these systems have clear benefits in that their efficient use can prevent personnel exposure to hot meal by removing build-ups before they result in blockages. In some cases they can also remove blockages without the need for internal intervention.

Operators should clearly identify points of build up in the pre-heater system and other areas. Static cleaning systems should then be installed to control the build up at these points. Operators should be trained and competent in their use, particularly on movable systems as vessels may have to be charged and connections made to the system.

4. Normal Cleaning & System Maintenance

Routine cleaning of some areas in the hot system may be required on an ongoing basis. Production personnel usually carry this out as part of the tasks undertaken during the shift.

The task is normally carried out with the system in production and as such under suction. There is however the potential for the discharge of hot material from the system if suction is lost.

In all instances looked at by the Working Group this task was planned and assessed as to risk; tasks were the subject of a safe system of work or procedure, which detailed the control measures in place when under taking this task.

Written Safe Working Procedures

Written safe working procedures should be readily available to the operatives. These procedures should at the least consider:

- A method of starting the job
- A method of ascertaining the extent and position of the build up or blockage
- A method of removing the build up or blockage.
- Details of the tools to be used and their storage and maintenance.
- A method of putting the system back into operation.

Trained and Competent Personnel

Trained and competent operatives must be used at all times. Operatives should only be deemed to be trained after a comprehensive training program and assessment by competent persons. Sufficient back up should be available to cover employees who may be away from work, on holiday or sick.

The numbers of personnel directly involved in the task must be kept to a minimum.

Restrict Access to Work Area

Access to the work area should be prevented for those not directly involved with the task. This can be done using a mixture of physical barriers and visual and audible alarms.

For example:

- Ensure access is denied to all areas (both local and remote) affected by the task with the use of lockable physical barriers.
- Ensure all effected floors are isolated by the use of lockable physical barriers.

Other Issues

Isolation of all static cleaning devices such as ‘air cannon’ or ‘blasters’ is essential while personnel access is available to the process. This is to protect employees from a number of hazards including exposure to high pressure air, exposure to hot material dislodged by the air cannon/blasters and potential discharge of material from the system caused by loss of suction.

The working area should be clean and secure. Water should not be allowed to accumulate where it can come into contact with hot materials, as contact can cause a steam outburst that can cause severe injuries.

There should be good access and egress from ‘inspection’ doors and rodding points.

Employees should be above the level of the blockage they are clearing and rodding holes should be downward facing.

There should be good dedicated communications with other workers involved in the cleaning and with the control room. Only *“Suitable & Approved”* personal protective equipment should be provided. (This subject is explored in another section of this report.)

5. Major Blockages

In these circumstances the potential for contact with hot meal is dramatically increased, but as stated elsewhere this contact should be kept to the absolute minimum. Where major blockages occur plants are taken off line and work can be undertaken at a measured pace in a more planned environment. The use of professional contractors can also be explored.

If there is concern as to whether the blockage is minor or major, a precautionary approach should be taken and the approach for major blockages should be implemented.

Once blockages are removed, the system needs to be brought back into production quickly and efficiently. All access points into the system should be resealed and closed. All equipment used to remove the blockage should then be returned to storage. A full investigation into the reasons for the blockage should be undertaken and any lessons that would prevent a reoccurrence should be learnt.

Written Safe Working Procedures

Written safe working procedures should be readily available to the operatives. These procedures should at the least consider:

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- A method of removing the build up or blockage.
- Details of the tools to be used and their storage and maintenance.
- A method of putting the system back into operation.

Trained and Competent Personnel

Trained and competent operatives must be used at all times. Operatives should only be deemed to be trained after a comprehensive training program and assessment by competent persons. Any contractors used to carry out this work must be experienced in the task, fully aware of the hazards and supervised by site personnel. The numbers of personnel directly involved in the task must be kept to a minimum.

Restrict Access to Work Area

Access to the work area should be prevented for those not directly involved with the task. This can done using a mixture of physical barriers and visual and audible alarms. For example:

- Ensure access is denied to all areas (both local and remote) affected by the task with the use of lockable physical barriers.
- Ensure all affected floors are isolated by the use of lockable physical barriers.
- Visual and audible alarms must be installed in all areas (both local and remote) affected by the task. Operation of these warning systems must be guaranteed by regular testing.

Other Issues

Isolation of all static cleaning devices such as ‘air cannon’ or ‘blasters’ is essential while personnel access is available to the process. This is to protect employees from a number of hazards including exposure to high pressure air, exposure to hot material dislodged by the air cannon/blasters and potential discharge of material from the system caused by loss of suction.

The working area should be clean and secure. Water should not be allowed to accumulate where it can come into contact with hot materials. There should be good access and egress from ‘inspection’ doors and rodding points.

Employees should be above the level of the blockage they are clearing and rodding holes should be downward facing.

The use of any tower lifts should be limited to those directly involved in the task.

There should be good dedicated communications with other workers involved in the cleaning and with the control room. Only *“Suitable &*

Approved" personal protective equipment should be provided. (This subject is explored in another section of this report.)

Use of Contractors (source: HSE publication 'Use of Contractors: a joint responsibility')

Cement companies and their contractors have general health and safety responsibilities to protect each other, their workforce, visitors and members of the public. Similarly if the contractor employs subcontractors to carry out some or all of the work, all parties will have some health and safety responsibilities; the extent of which will depend on the circumstances. All parties most co-operate to ensure that health and safety is properly managed.

The health and safety implications of the blockage clearance need to be considered. This will involve selecting a suitable contractor, a risk assessment, determining what instruction and training is required, how co-operation and co-ordination between all parties can be achieved, how the workforce is to be consulted and the level of management and supervision required.

Cement companies will need to satisfy themselves that contractors are competent to do the job safely and without risks to health and safety. HSE suggest asking contractors about their experience, H&S policies and practices, recent H&S performance, qualifications and skills, subcontractor selection procedure, provision of H&S training and supervision, arrangements for consulting the workforce, any independent assessment of their competence, membership of relevant trade or professional bodies and whether they hold a 'passport' in H&S training. A decision can then be made on how much evidence needs to be sought to support what prospective contractors have said.

The cement company will then need to agree the risk assessment with the contractor and the preventative and protective steps that will apply when the work is in progress. If subcontractors are involved they should also be part of the discussion and agreement.

Employees must be provided with information, instruction and training on anything which may affect their health and safety. This needs to take account of the risks of the activities of all parties. Furthermore, all parties need to exchange clear information about the risks arising from their operations, including relevant safety rules and procedures, and procedures for dealing with emergencies. The information should include details of any risks that other parties could not be reasonably expected to know and must be specific to the work.

There must be co-operation and co-ordination between all parties involved and liaison meetings should be set up. The workforce must be consulted and they should be part of the liaison arrangements.

Contractors must be effectively managed and supervised. The more impact the contractors work could have on health and safety, the greater the management and supervisory responsibility. Responsibilities also increase where the cement company knows more about the health & safety implications of the contracted work than the contractor. The nature of control should be agreed before any work commences.

How the work will be carried out and the precautions that need to be taken may need to be agreed with the contractor. Relevant issues include

- What equipment should or should not be worked on/used
- PPE to be used and who will provide it
- Working procedures, including any permits to work
- The number of people needed to do the job
- Accident reporting & safekeeping of records/ plans.

Checks will be required to ensure the risk assessment is up to date and that control measures are working. Periodic checks will be necessary on the contractors performance to see if work is being done as agreed. Accidents and near misses should be investigated and lessons learnt. Any failure to meet requirements should be put right or the contractor should be stopped from working on the job until requirements can be met.

6. Personnel Training

A trained and competent workforce is less likely to suffer accidents or incidents when confronted with a situation involving hot meal and hot meal systems.

All personnel involved in the production process should be trained to prevent blockages and build up occurring. The training should also extend to dealing with blockages and build ups safely when they occur. This should include training in the use of Personal Protective Equipment.

The desirability of early warnings of blockages and the importance of kiln control/kiln feed chemistry have been explained under item 3. Reducing Personnel Exposure. Methods of communication need to be set up to alert other process staff of potential hazards and to correct the kiln feed before blockages occur.

Where kiln systems have not yet been fitted with automatic monitoring devices, the kiln system should still be monitored closely for temperature and pressure variations, which could indicate a blockage and the system, shut down for investigation. Kiln operators must be able to recognise the early warning signs and understand the importance of a quick response.

7. Completion of Pre-heater Tower Work

As with all jobs carried out on the hot meal system, the final completion of the work must be planned and carried out correctly.

A procedure should be established for the orderly completion of pre-heater tower work which should include:

- Confirmation that blockage is clear using appropriate methods.
- Ensuring all poke holes, covers and doors are closed and sealed.
- Cordoning off and securing any remaining hot meal (erect warning signs as required).
- Checking any affected area for fire.
- Returning all equipment to safe and secure storage.
- Communicating that the blockage is clear and removing or deactivating any warning signs or signals.
- Reinstating any static cleaning devices and test.
- Reviewing the incident to determine probable cause, drawing out the lessons to learn, debriefing the team.
- Ensuring that all investigations of this type of incident are communicated to all employees and other interested parties. (It should be remembered that all cement manufacturers share the same problems and can only benefit from each other's experiences).

8. Personal Protective Equipment

Under the hierarchy of control measures Personal Protective Equipment (PPE) is the last control measure to be considered. However the type and effectiveness of the PPE provided for both breakdown or blockage and normal cleaning / coating removal is vitally important.

The requirement to undertake risk assessments under the Management of Health and Safety at Work Regulations 1999 is set out under 3. Reducing Personnel Exposure. It will be necessary to ensure that these risk assessments are also compatible with the Personal Protective Equipment Regulations 1992 (as amended) and/or for specific legislation if applicable (e.g. COSHH, confined spaces etc); where PPE is selected.

The kiln system is hot externally as well as

internally, so persons working on the system will need to be protected at all times while working on the system itself or in areas with a potential for hot meal burns or other thermal burns. To this end a manual of the PPE in use at various sites has been compiled.

PPE provided to employees must be appropriate to the hazard encountered and take into account the ergonomics of the individual/task/environment. It should fit correctly and be compatible with any other PPE worn. It must comply with relevant legislation and be marked to CE or equivalent standard. Appropriate storage should be provided for PPE that protects it from damage. PPE should be properly maintained and any defects should be reported. Employees should be trained and instructed in the use of PPE.

9. Effects and Treatment of Burns

Misconceptions over the classification of burns and their correct treatment were found amongst front line employees at a number of sites visited by the Working Group that prepared this guidance document. Consequently, the following section was compiled with assistance from Dr Moinmen of Selly Oak Burns Unit.

Thermal Burns

When a burn occurs not all the damage happens at once. Because the body holds heat, the burning process can last for several minutes to several days or even longer in the case of serious burns. These burns can also lead to the loss off hair follicles, sweat glands, and nerve endings and may lead to skin grafts. **Immediate treatment has been found to decrease the degree and depth of the burn.**

For this purpose, emergency showers must be installed in all areas where there is a risk of exposure to the hot feed system.

First aid for thermal burns:

Speed is the most important single factor in burn treatment. The more quickly you cool down the burn the better your chances of reducing its effects.

Use water from a shower, a hose, a sink or whatever water source is closest. Hold the burn under cool running water and seek medical advice.

Most of us will experience at least one painful burn in our working lives, remembering this simple, effective first aid treatment is an easy way to relieve the discomfort of a burn and prevent lasting burn damage.

Alkali Burns

Cement and other powders within the manufacturing process are alkali substances and as a result may cause burns. If these powders come into contact with the skin and reacts with sweat or other sources of moisture, then a reaction can occur which releases heat. Typically the victim does not know for hours that a burn has occurred, as it is often a painless process under clothing.

If the agent is left on an unprotected part of the body for any period of time this can cause the fat in the skin to turn in to a substance which will burn and can penetrate the tissue. The severity of the injury is generally measured by the duration of exposure. Raw meal burns may often lead to full-thickness skin loss, and destroy ectodermal elements such as hair follicles, sweat glands and nerve endings.

First aid for alkali burns:

1. While protecting yourself, brush off dry particles from the victim's skin.
2. Wash with soapy water and rinse for at least 20 minutes, remember that heat is released when alkalis are mixed with water, so it is really important to irrigate for at least 20 minutes.
3. Do not attempt to identify specific neutralising agents when you should be irrigating the burn area.
4. Seek medical attention.

10. Heat Stress

HSE have produced guidance on heat stress risk assessments and on what can be done to avoid heat stress occurring;

- Control temperature
- Provide mechanical aids
- Regulate exposure time
- Prevent dehydration
- Provide specialised PPE
- Provide training
- Allow acclimatisation
- Identify employees who are susceptible
- Health Monitoring

The HSE guidance should be followed where appropriate. The guidance can be obtained from the HSE website: *www.hse.gov.uk/pubns/geis1.pdf*

11. Legal Context

Health and Safety at Work Act Section 2

Employers duty of care is set out in section 2 of the Act. Particular obligations include:

- Providing and maintaining plant and systems of work that are safe and without risks to health.
- Providing such information, instruction, training and supervision to ensure that employees can carry out their jobs safely.

The Health and Safety at Work Regulations detailed below are generally more explicit than the Health and Safety at Work Act.

Management of Health and Safety at Work Regulations 1999

The regulations require employers to carry out a suitable and sufficient assessment of the risks for all work activities for the purpose of deciding what measures are necessary for safety.

A hierarchy of control measures is set out that has legal status. Schedule 1 of the regulations sets out the following principles of prevention;

(a) avoiding risks;

(b) evaluating the risks which cannot be avoided;

(c) combating the risks at source;

(d) adapting the work to the individual, especially as regards the design of workplaces, the choice of work equipment and the choice of working and production methods, with a view, in particular, to alleviating monotonous work and work at a predetermined work-rate and to reducing their effect on health;

(e) adapting to technical progress;

(f) replacing the dangerous by the non-dangerous or the less dangerous;

(g) developing a coherent overall prevention policy which covers technology, organisation of work, working conditions, social relationships and the influence of factors relating to the working environment;

(h) giving collective protective measures priority over individual protective measures; and

(i) giving appropriate instructions to employees.

Local/task specific risk assessments should be the norm in addition to area specific risk assessments. It is important that the Working Group recommendations are considered as part of the overall risk assessment. This will allow any health and safety conflicts that might arise from the recommendations, e.g. because of a higher priority risk, to be resolved at the local level.

Ultimately companies and sites are responsible for the nature and scope of the controls that need to be implemented based on their health and safety policy and in particular the site specific risk assessment.

This guidance focuses on hot meal and there may be other hazards associated with clearing and hot working in pre-heater towers systems and coolers; these hazards may be subject to other legislation. Examples include the Confined Space Regulations 1997, COSHH, the Provision & Use of Work Equipment Regulations 1998 and the Work at Height Regulations 2005. Risk assessments should take account of all relevant legislation

Further Reading: Management of Health and Safety at Work Regulations 1999: Approved code of practice and guidance L21 HSE Books ISBN 0 7176 2488 9.

Personal Protective Equipment Regulations 1992 (as amended)

The main requirement is that PPE should be supplied and used at work wherever there is a health and safety risk that cannot be controlled in any other way.

The regulations also set out requirements relating to assessment, training (including regular checks that PPE is used correctly), maintenance (including storage) and the requirement to use CE marked equipment (when supplied after 1995).

Further Reading:

Personal Protective Equipment Regulations 1992: Approved code of practice and guidance L21 HSE Books ISBN 0 7176 2488 9.

A short guide to the Personal Protective Equipment Regulations 1992-IND(G) 174

www.hse.gov.uk/pubns/ppeindex.htm

12. Personal Protective Equipment Catalogue

The following photographs have been compiled to illustrate the various types of PPE currently being used during high temperature cleaning operations at different cement works.

On each page details are given of a contact who will:

- **provide supplier and manufacturer details**
- **give advice about the suitability of the equipment for certain conditions**
- **explain the benefits or drawbacks of particular items.**

Responsibility for equipment selection lies with the employer and must be based on a specific risk assessment.

CASTLE CEMENT: CLITHEROE WORKS

Contact: Chris Fish Tel: 01200 414 320 E-mail: chris.fish@castlecement.com

An airflow helmet with combined front and back apron. During operation the helmet is attached to an airline which feeds a constant flow of filtered fresh air from a special low pressure compressor.

The TST fireman's suit is available in heavy duty (left) or light duty (right). Both have zip fronts and Velcro seals.

Cleaning specialists Powerclean UK Ltd. use the above PPE when clearing pre-heater blockages, and believe the equipment provides excellent full body protection, whilst allowing good manoeuvrability. To ensure good communications between members of the cleaning team, a three way radio link is fitted inside the helmet.

LAFARGE CEMENT DIVISION:

Contact: Richard Harrhy Tel: 01446 752371 E-mail: : richard.harrhy@Lafargecement.co.uk

Gallet Helmet (MSA Scotland)

Detachable Visor

Nomex Snood Hood (Arco)

Neptune Kevlar 18” Sleeve (Protec Manchester)

LAFARGE CEMENT DIVISION: CAULDON CEMENT WORKS (below)

Contact: Ian Dawson Tel: 01538 309 418 E-mail: ian.dawson@lafargecement.co.uk

Gallet helmet with neck cover

Kevlar sleeve

LAFARGE CEMENT DIVISION: CAULDON CEMENT WORKS (below)

Contact: Richard Harrhy Tel: 01446 752371 E-mail: richard.harrhy@Lafargecement.co.uk

Neptune Kevlar gloves (Protec Manchester)

LAFARGE CEMENT DIVISION: CAULDON CEMENT WORKS (below)

Contact: Ian Dawson Tel: 01538 309 418 E-mail: ian.dawson@lafargecement.co.uk

Nomex balaclava

Gallet helmet with neck cover

BUXTON LIME INDUSTRIES: TUNSTEAD QUARRY CEMENT WORKS (below)

Contact: Paul Downes Tel: 01298 76 8246 E-mail: paul.downes@tarmac.co.uk

The design of this suit is very similar to the silver suit, with double Velcro seal down the front.

CASTLE CEMENT: CLITHEROE WORKS

Contact: Chris Fish Tel: 01200 414 320 E-mail: chris.fish@castlecement.com

Aluminised one piece suit with zip fastener and studded seal.