

## **M502: THERMAL ENVIRONMENT**

### **STUDENT EXERCISE 1 – HOT ENVIRONMENTS**

#### **BACKGROUND**

Raw coal is converted to coke by heating it to high temperatures in the absence of air in individual coke ovens in a battery of ovens.



***Photograph 1 – View of a Coke Ovens Battery***



***Photograph 2 – View of Top of Coke Oven Battery***

The coke oven is a refractory brick lined cavity measuring approximately 17 m long, 5 m high and 450mm wide. The oven is heated from either side by gas fired heating chambers which are heated to approximately 1200°C to allow the conversion of coal to coke. Typically there are approximately 50 ovens in a modern battery.

Over time damage occurs to the refractory linings of the ovens and repairs need to be undertaken to prolong the efficient production life of the batteries.

The process involves the oven to be repaired being taken out of service and while the oven is still red hot, refractory brickwork walls and floors are progressively removed by hand, working inwards to a distance of approximately 5 metres. Once all the damaged brickwork is removed the oven is rebricked and returned to service.

Photographs 3, 4 and 5 show the restricted area of the oven where the damaged brickwork is repaired.



***Photograph 3 – Refractory Worker Wearing His Typical PPE***



***Photograph 4 – Hot Brickwork Inside the Oven***



***Photograph 5 – Refractory Brick Wall to be Removed***

Issues that arise during the repair process include:

- Cannot allow the refractories to cool down – brickwork will collapse
- High radiant heat – 900°C has been measured on a person's back when working inside an oven
- Confined space
- Carbon monoxide
- Restricted and awkward area to work in

- Hot and heavy hard work
- Working from scaffold / platform
- Heavy bricks
- Manual handling
- Not always immediate access to water on site
- No defined cool rest area close to job site

Clothing and PPE worn typically includes:

- Standard long cotton drill trousers and shirt
- Underwear and T shirt
- Safety boots
- Leather gaiters
- Heavy duty “furnace” coat
- Balaclava
- Hood
- Safety helmet
- Disposable respirator
- Safety glasses
- Heavy duty gauntlets with gloves underneath
- Face visor

**Note:** *A Refrasil (ceramic fibre) lined protective cage is installed for the protection of workers from falling brickwork.*

The work practices and procedures historically used during the repair process include:

- Refractory workers were “used to the hot and heavy work conditions”
- Known and anticipated part of job
- Job has always been done this way
- One on job supervisor and eight labourers

- Workers were willing and the heat tolerant “went in” and worked as long as they physically could (1 – 2 minutes) came out onto the platform for a short rest and then went in again and repeated until could not tolerate any more
- Often a rip and bust approach
- Job rotation practiced within the group of workers
- Next person repeated the process and so on till all the brickwork removed
- Heat damaged safety helmets, visors, gloves in early stages of removal
- Often feelings of lightheadedness, headaches, feeling nauseous, dizzy, drenched in sweat
- Heat levels reduce with time as brickwork progressively removed and oven opened up. Once all the brickwork was removed the space temperature decreased to “comfortably warm”
- Meal breaks taken to fit in with production schedules of battery
- No history or reports of heat related injuries

**QUESTION:**

What investigations and recommendations would you suggest?

**Note:** Assume for the exercise that Isolation procedures, Work Permits, Confined Space Entry procedures, etc are all in place.