

**COBRA MIDDLESBROUGH LTD
NORTH ROAD.
MIDDLESBROUGH**

Cobra is a storage and distribution terminal handling around 1 million tons of rock salt per year for de-icing the winter roads.

The rock salt arrives by train from a coastal mine and is tipped and stockpiled in various locations around the site. Some of the salt is crushed and graded into smaller crystals whilst some is treated with de-icing chemicals.



Cobra's front shed

Approximately 70% of the salt goes out by road to all the corners of Britain, about 20% is loaded on ships for use in Europe and beyond, while the remaining 10% is graded for animal feed.

Three quarters of this salt is stored outside but Cobra has two giant sheds for storing and processing dry salt.



Cobra's back shed (animal feed shed)

THE PROBLEM

Salt being hygroscopic brings with it its own problems, as the moisture content is quite critical for the 10% of the salt that makes up the animal feed stocks.

The animal feed shed is 50m long, 40m wide and 20m high at the highest point, it contains 26,000m³ or nearly 1 million cubic feet of air.

There is no heating in this storage shed; the air inside is normally the same temperature and relative humidity (RH) as the external air.

Internal RH is therefore critical, when external RH is high problems are unavoidable

The salt absorbs the moisture from the air like a sponge.
On the salt stockpile, the top 100mm layer rapidly becomes sticky and wet.
The wet salt blinds the sieve screens and clogs discharge chutes.
Any surface with a layer of salt dust on becomes slimy and increasingly corrosive.
All floor areas become slippery and dangerous.



The animal feed screening system

This is an extremely hostile environment where machinery deteriorates at an alarming rate and moisture-laden salt becomes unusable for animal feed.

Cobra uses an additive to absorb the excess moisture in the finished salt products. This acts as a flow agent to aid salt discharge from hoppers and storage bins and also as a drying agent. It is quite slow acting and can only be used in small amounts as food standard agencies dictate the maximum amount of additives per ton. It is also relatively expensive.

When the salt is too wet, it is rejected therefore a suitable solution needed to be installed and employed.



The additive system

SOLUTION

The key to minimising problems is to keep the temperature of surfaces and materials in the shed, as far away from the Dewpoint temperature as possible. To raise the air temperature by 8 - 10°C above ambient, creates conditions much further away from the dewpoint temperature and therefore prevents condensation and reduces the hygroscopic effect on the salt.

By employing the Dryair “**Moisture Flush Process**” and installing one DRYAIR EU 240 system along with four PHE 60 exchangers, the air temperature can be raised by as much as 20 - 25° above ambient, reducing RH dramatically.

Example: -

If we raised the temperature inside the shed from 8°C to 18°C, the relative humidity would fall to around 45%.

If we raised the temp by 12°C to 20°C, the RH would fall to around 38%.

The PHE 60's move 3,200m³ each or 12,800 m³ / h for all four.

It would therefore take three hours to replace all the air.

Based upon an incoming air temperature of 8 °C, the hot air leaving the heat exchanger would be 55°C.

33% of the sheds air can be heated in 1 hour.

This would give an overall temperature of 25.6°C minus the heat loss from cooler air and from the lack of insulation within the building, giving an average temp of **18°C**.

The DRYAIR equipment operates on a “Moisture Flush” system.

The four heat exchangers push 12,800m³ of hot air into the building every hour. This creates a positive pressure and forces the same amount of warm humid air out of the building

*Four PHE 60 heat exchangers
in their protective shed.*



The EU 240 water heater in its house

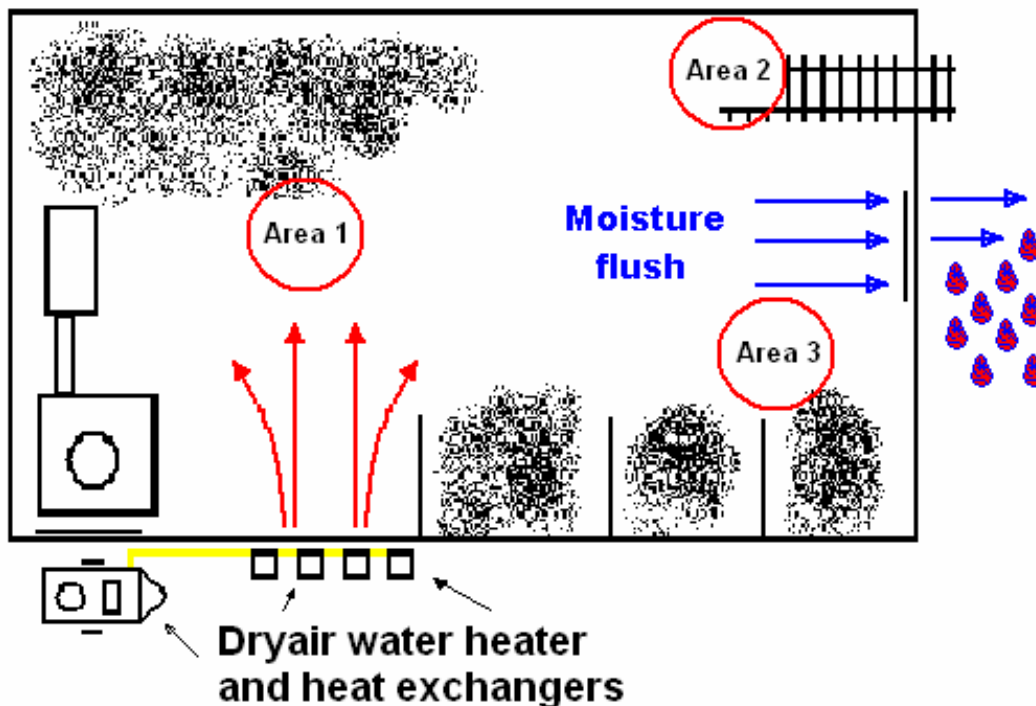
Monitoring

The Cobra yard supervisors historically have a good idea of dewpoint.

They are aware of the type of weather that results in problems. To back up this intuition, temperature and humidity readings are taken at various times & locations through out the day.

When the dewpoint is close or when damp salt arrives via train, the Dryair system is switched activated.

The yard supervisor decides how many heat exchangers to use to keep dew point at bay, as weather conditions improve; the system may be amended or turned off.



A floor plan with monitoring stations

	DATE	TIME	OUTSIDE	AREA 1	AREA 2	AREA 3	WEATHER	COMMENTS
TEMP °C	25/10/2005	9.00	13.1	12.9	12.9	13.0	Heavy rain	Started system
HUMIDITY %			84.0	85.2	84.8	85.1		Shed was slimy / wet
TEMP °C		11.00	13.5	22.8	19.5	19.8	Heavy rain	Conveyors now dry
HUMIDITY %			86.1	49.9	53.2	53.8		All droplets gone
TEMP °C		13.00	13.5	24.0	22.4	20.3	Drizzle	Shed floor dry
HUMIDITY %			85.8	30.2	47.2	50.1		

An excerpt from the monitoring log book

The Moisture Flush Process

Moisture Flush is the method of using air as a medium to expel moisture laden air out of a building using heat and positive pressure. Hot air is distributed around a room using the natural movement of convection; hot dry air rises up and displaces the air on the ceiling. The air on the ceiling then rolls down the walls and across the floors. The Dryair system, in many instances, reduces the RH to less than 5%, this results in the dry air acting as a sponge, absorbing moisture from both the surface and mass of the host materials. The positive pressure takes the humid air and expels it out via the nearest ventilation points.

TECHNICAL SPECIFICATION

The Dryair EU 240 is a 240Kw or 900,000btu water-heating module. It is diesel fired and consumes 22 litres per hour in a maximum heat (worst case scenario)

However in economy mode (maintaining heat) only 10 per hour will be burnt.

The unit is powered by a generator but can also run on mains (240v single phase) electricity.

The PHE 60 heat exchangers are 60Kw or 200,000btu.

The systems electrical energy consumption is: -
4 x PHE 60 consume 5.6 kilowatts of electricity per hour
EU 240 consumes 3.3 kilowatts of electricity per hour

Combined, this is 8.9 kilowatts (37 amps) at maximum or 4.4 kilowatts (18 amps) on economy.

HEAT MODE

In this mode, maximum heat is produced from all four heat exchangers. This continues until the sheds air temperature has been raised sufficiently to affect dew point, the moisture-laden air being expelled via the side doors. Once achieved, the economy mode may be used.

ECONOMY MODE

After the sheds air has been heated and expelled, or when a cold dewpoint is forecast, economy mode may be used. In this mode, only two of the four heat exchangers are used. As the heat demand from the system decreases, the unit senses the temperature change and shuts down to conserve fuel. When the heat demand increases, the drying module will fire back up.

This halves the electric and diesel consumption.