

Blast Furnace Top Gas Water Treatment

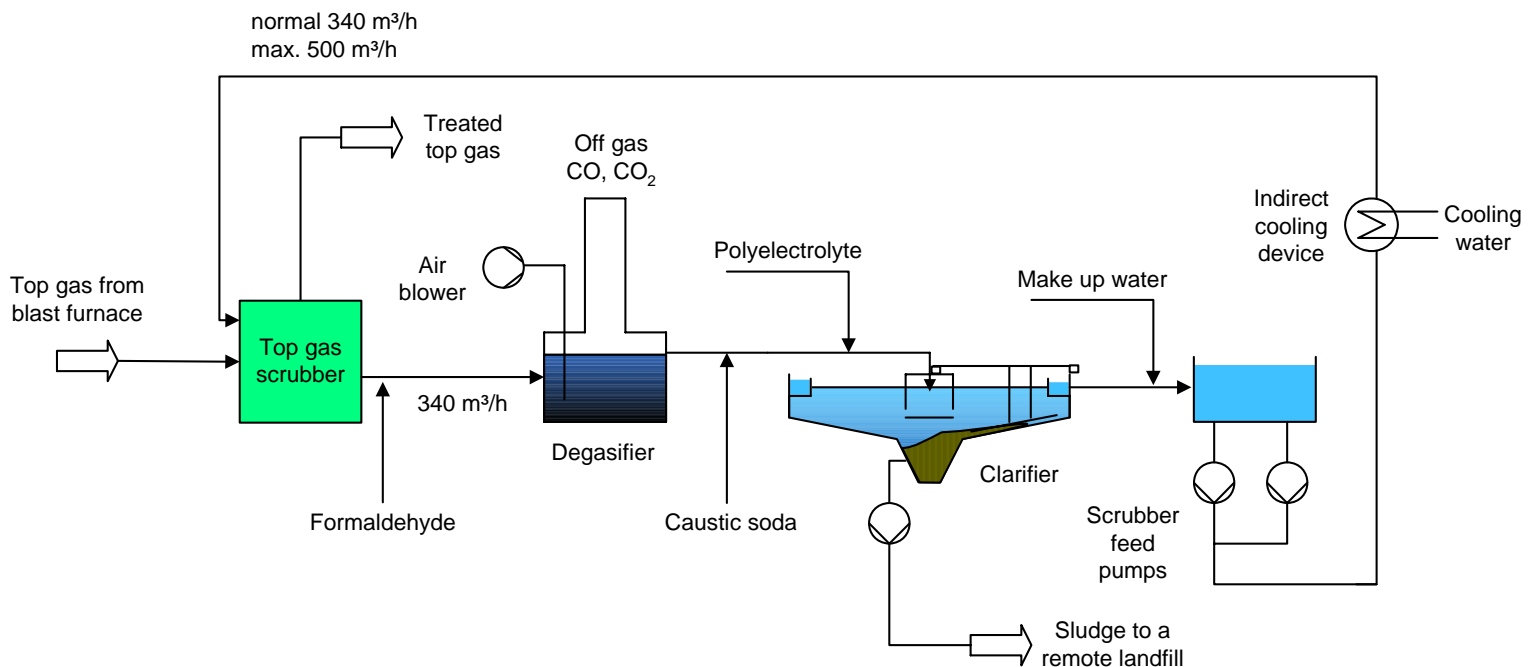
**OneSteel
Whyalla**



Manufacture of hot metal in blast furnaces produces process gas that is heavily contaminated with dust and always contains large amounts of carbon monoxide (CO) as a result of the highly reducing process conditions, together with some hydrogen cyanide (HCN) and carbon dioxide (CO₂). Process gas cleaning by wet scrubbing results in the wash water absorbing appreciable quantities of these gases along with the dust. In view of stringent environmental pollution control all modern blast furnace plants employ a closed-circuit wash water recirculation system. A plant of this type was designed by Lurgi Bamag and executed by Outokumpu Lurgi (Australia) Pty Ltd. as a turnkey project for No.2 Blast Furnace at OneSteel, Whyalla, SA, Australia.

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1. Objective

Water treatment of blast furnace top gas

- Design data

Capacity	340 m ³ /h
Temperature	≤ 50 °C
- Treatment criteria

SS	≤ 100 mg/l
Zn	≤ 15 mg/l

2. Plant concept

- Process steps
Degasification, pH - control, sedimentation, cooling, sludge land-filling

2.1 Degasifier

The wash water first enters a degasifier, where the highly toxic gas carbon monoxide and free carbon dioxide are removed by an upward flow of stripping air. The off-gas is discharged through a stack. Caustic soda may be added at the effluent of the degasification tank to adjust the pH-value to the desired value.

2.2 Sedimentation

After leaving the degasifier, the water is flocculated with poly-electrolyte and routed to a clarifier-thickener, where the suspended solids are separated by sedimentation. The treated effluent runs to a hot well to which fresh make up water is added at a controlled rate to compensate for losses. From the hot well the water is pumped to the scrubber passing a cooling system, thus closing the circuit.

2.3 Cooling

On its way to the scrubber, the clean pressurised hot scrubber water is passing a heat exchanger to cool it down to below 30°C. Salt water from the sea is used as a coolant.

2.4 Sludge landfilling

Thickened sludge as well as the necessary blow-down of the scrubber water is pumped to a remote landfill by means of a speed-controlled centrifugal pump.

3. Process highlights

3.1 Carbon monoxide degassing

The top gas scrubber and degasifier are connected by an enclosed pipe installed on a ridge and fitted with cleaning ports. Following degassing, the CO concentration measurable above the open water surface is no more than trace level (less than 2 ppm), quite in contrast to treatment systems without degasifier where the CO level may frequently exceed 50 ppm or more in wafts of gas. Containing the CO-contaminated wash water exiting the blast-furnace top gas scrubber in an enclosed pipe - as distinct from common past practice of using open channels thus allowing free escape of the gas - and degassing the water with controlled off-gases release through a stack at a safe height makes a very substantial contribution to workplace health and safety.

3.2 Carbon dioxide degassing

Free carbon dioxide, too, is stripped from the water in the degasifier, thus reducing scale formation in the

scrubber water circuit to a level at which it can readily be controlled by chemicals (antiscalants). This adds considerably to the reliability of blast furnace operation and reduces the costs for caustic soda for pH-control.

3.3 Indirect cooling

Cold salty seawater is used as a coolant and is returned into the sea without cooling.

Compared to evaporation cooling towers the following is avoided:

- water loss by evaporation and drift
- no uncontrolled degassing and scaling
- no excessive space consumption
- no noise

3.4 Hydrogen cyanide

In periods of high HCN generation (run down of BF), scrubber water circuit will be closed. Formaldehyde will be dosed to form non-toxic compounds. During standard operation only traces of HCN are present.

3.5 Solids inventory thickener

The solids inventory is permanently measured to protect and supervise the clarifier.