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The Application of a New Wet Scrubber to the HCN Removal in Gold Mining

Optromix Company presents the new type of multi vortex wet scrubber. The multi vortex wet scrubber can be used to remove dangerous gases, particulate matter, vapors and other contaminants from the air to meet EPA and OSHA requirements. The difference of the multi vortex wet scrubber is that it uses up to 10 times less cleaning liquid than a typical wet scrubber. This water- and reagent-saving device has found wide applications in gold mining.

Introduction

The multi vortex wet scrubber is a new generation of foam wet scrubbers that has a very stable operation in harsh environments using cleaning liquid with high mineralization and high impurities content. The multi vortex wet scrubber can work for extended periods of time using the recirculating cleaning liquid. The multi vortex wet scrubber decreases liquid consumption up to 10 times compared to a typical foam wet scrubber.

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The cleaning liquid does not require a special treatment and may contain solids (e.g. sand, small rocks) and other contaminants. For this reason the cleaning liquid may be used after other process cycles, thus achieving considerable savings.

The self-cleaning grating is the multi vortex wet scrubber core patented technology. It is usually made of plastic (polypropylene) or stainless steel (for high temperature applications >300°F). This grating does not fray and does not grow scaling, even when using cleaning liquid with mineralization of up to 15.6 lb/cf

The self-cleaning grating is assembled from the standard square-shaped elements. The grating size is determined by the required system capacity. Structurally, the grating consists of divergent holes formed by vanes to provide a turbulent stabilization of the foam layer without external stabilizers. The multi vortex wet scrubber capacity may vary from 600 cfm to 150,000 cfm. It is possible to place several grating layers one above another in the Scroiler™ system to achieve the required efficiency.

HCN Cleaning Application in Gold Mining

The multi vortex wet scrubber was applied to the HCN removal at the gold mining facility.

When the HCN concentration did not exceeded 1 mg/m^3, the treatment quality of 95.0% was achieved with a NaOH neutralizing reagent. The outlet HCN concentration was from 0.015 mg/m^3 to 0.03 mg/m^3 depending on the inlet HCN concentration. The treatment quality shows strong dependence on the circulating liquid pH (Fig. 1).

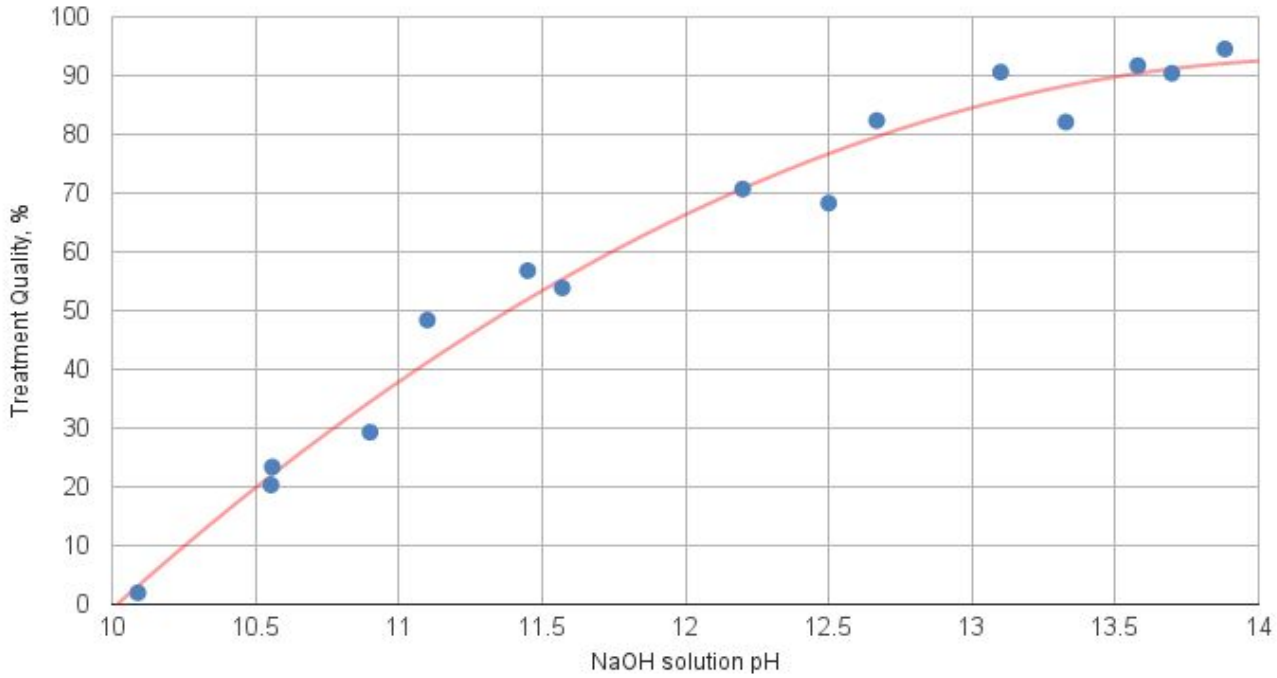

Figure 1. HCN treatment quality dependence on the circulating NaOH solution pH.

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When the HCN concentration exceeded 100 mg/m^3 the treatment quality of 97.0% was achieved with 5% $Ca(OH)_2$ lime milk as a neutralizing reagent. The outlet HCN concentration was from 6.4 mg/m^3 to 10.6 mg/m^3 depending on the inlet HCN concentration (Fig. 2).

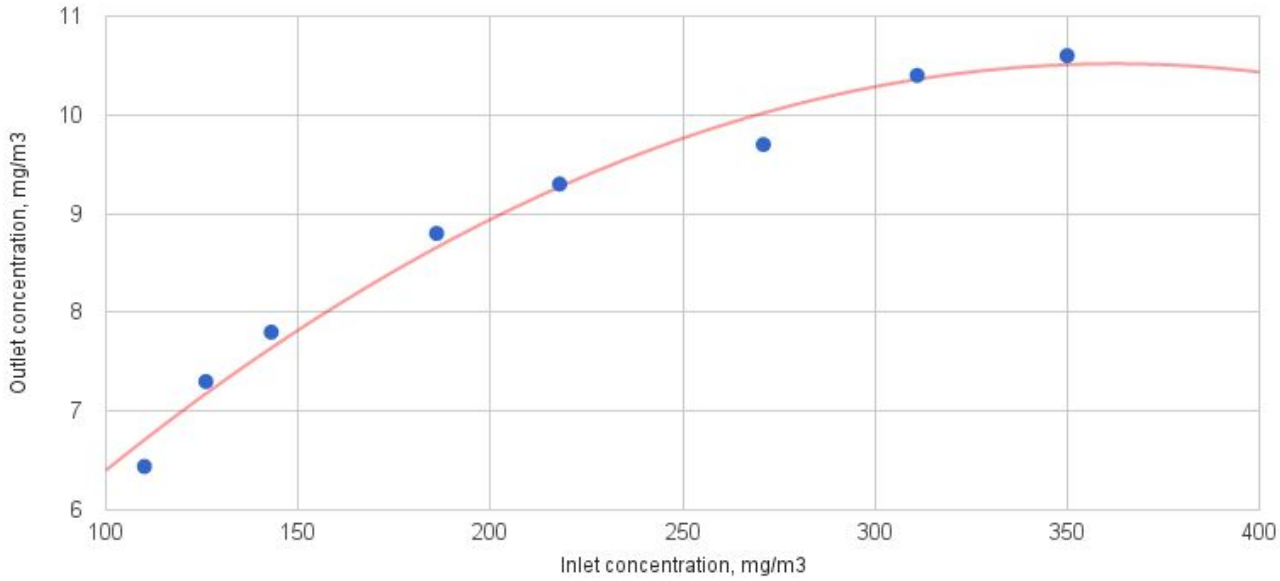

Figure 2. HCN outlet concentration on the inlet concentration dependence with 5% $Ca(OH)_2$ lime milk treatment.

The treatment quality test series at high HCN concentration and NaOH as a reagent were not performed because $Ca(OH)_2$ results had satisfied the client. The client concluded that a 99.9% treatment quality is achievable and exceeds the process requirements.

Thus, for the effective HCN removal a reagent should be added to the water. At higher HCN concentrations (> 100 mg/m^3) and the required treatment quality of not less than 95% the cost-effective reagent is 5% $Ca(OH)_2$ lime milk. At the low HCN concentrations (< 10 mg/m^3) the high pH solution should be added (e.g. NaOH) to achieve the 99.9% treatment quality.

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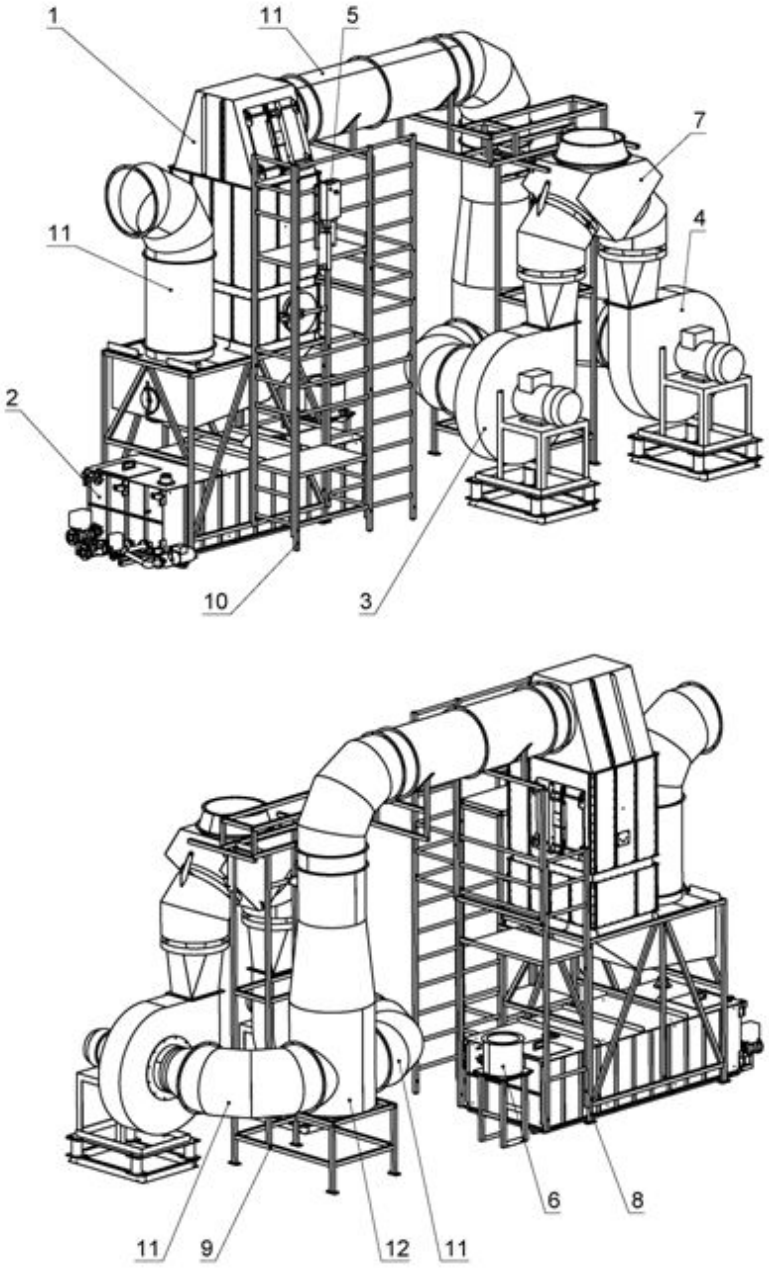
The multi vortex wet scrubber structure and specifications



The multi vortex wet scrubber consists of the following components: 1 - The Scroiler™ chamber; 2 - Circulation tank; 3 - Right blower; 4 - Left blower; 5 - Dispenser; 6 - Reagent preparation tank; 7 - Two-way valve; 8 - Frames; 9 - Racks; 10 - Service platform; 11 - Ducts; 12 - Collector. The installation also includes automation and control cabinets.

Contaminated air enters the multi vortex wet scrubber chamber (1) driven by the underpressure generated by the blowers (3, 4) and extends upwards inside through the dispersive grating. The

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cleaning liquid accumulates in the dispenser (5), from which it enters the Scroiler™ chamber (1) wherein it distributes evenly over grating and breaks into the droplets in the formed streams of the contaminated air. The result is the turbulent gas-liquid dispersion layer that is held over dispersive grating by the balance of air pressure force and the gravity force. In this layer the surface contact between gas and liquid is maximized. The layer has high structural uniformity and high recirculation rate. All this determines a high degree of the air purification by an intensive chemical reaction between the gaseous pollutant and the reagent. The purified air exits the chamber through the duct 12, then to the collector (12), and the fan (3) or (4), then through the two-way valve (7) exits the system. The system operates continuously.

Typical Scroiler™ system specifications

Capacity (typical)	12,000 ... 16,000 m^3/h	7,000 … 9,500 cfm
Pressure drop	2 kPa	0.29 psi
Inlet gas temperature	+5…+75 °C	40 … 170 °F
Cleaning liquid circulation	5 m^3/h	2.9 cfm
Cleaning efficiency	95.0% … 99.9%	

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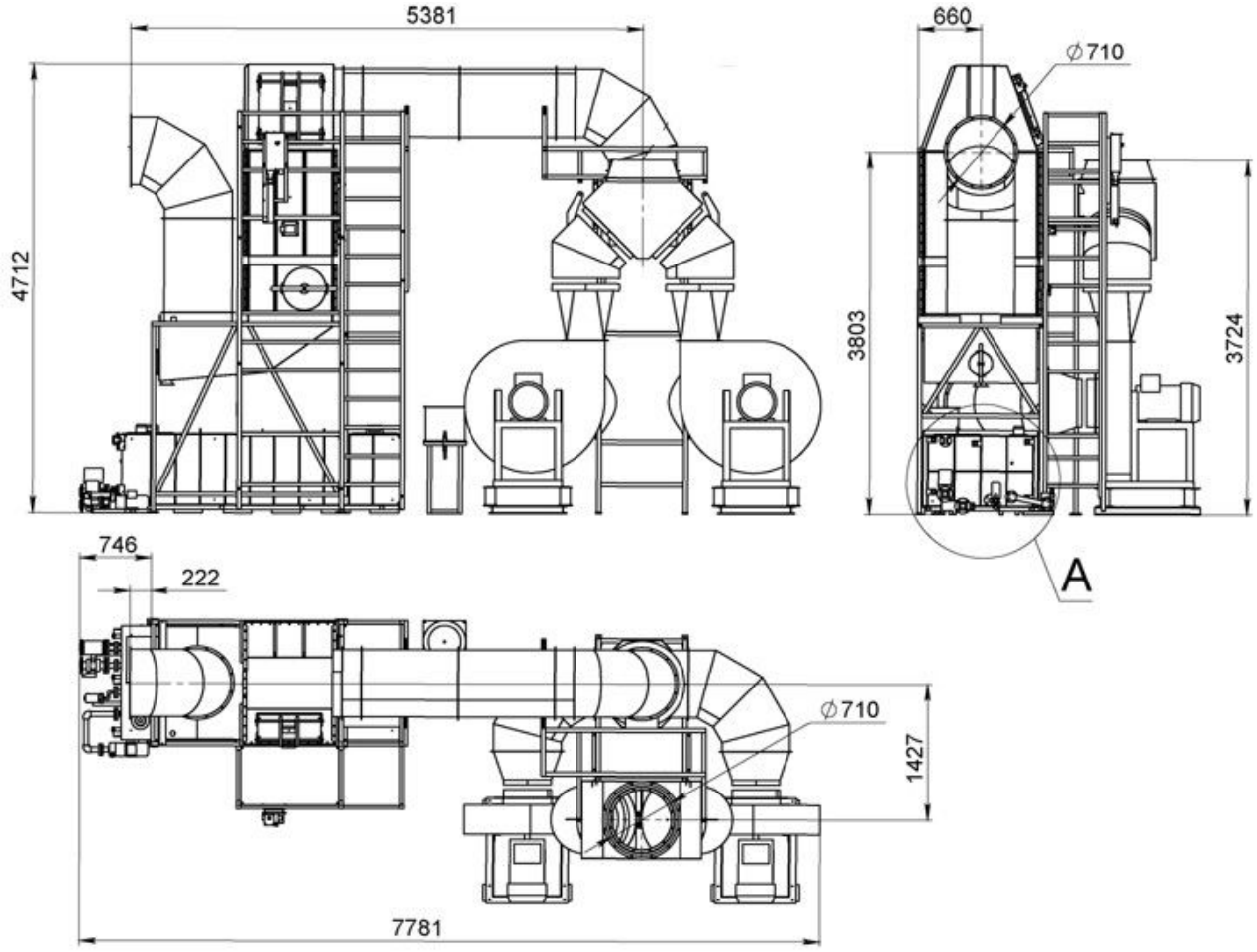
The multi vortex wet scrubber Dimensions



The Scroiler™ system dimensions in mm.

Example of the custom installation package

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Height	4,712 mm	185.5 in
Width	2,856 mm	112.4 in
Length	7,781 mm	306.3 in
Net weight	3,800 kg	8,400 lbs
Transportation package	6 crates, two 20-ft shipping containers	
Crate 1 (ducts, frames, racks)	3,350 x 1,150 x 2,350 mm	300 kg / 661 lbs
Crate 2 (upper Scroiler™ chamber)	3,200 x 1,150 x 1,700 mm	300 kg / 661 lbs
Crate 3 (ducts)	3,100 x 1,000 x 2,350 mm	600 kg / 1,323 lbs
Crate 4 (lower chamber, tank, valve)	3,400 x 1,400 x 2,350 mm	900 kg / 1,984 lbs
Crate 5 (left blower)	1,700 x 1,200 x 1,800 mm	550 kg / 1,213 lbs
Crate 6 (right blower)	1,700 x 1,200 x 1,800 mm	550 kg / 1,213 lbs

9.500 cfm multi vortex wet scrubber chamber installation at the Polymetal Corporation facility