

Vortex Ecological Technologies Ltd.

Case Study:

Vortex achieves 99.9% emission cleaning at Rotem Amfert Negev

Rotem Amfert Negev Ltd (hereafter "Rotem") is an integrated, multinational company which mines and beneficiates phosphate rock and produces a comprehensive range of products based on phosphate rock as raw material, leading to downstream derivatives such as phosphoric acids, fertilizers, specialty chemicals and phosphate salts.

The Challenge

Dust is emitted at various stages of handling and processing throughout Rotem's facilities, such as crushing, handling, drying, storage etc. The target for the Wet-Vortex system was to achieve substantial reduction of dust emission of Rotem's crushing plants.



Wet-Vortex installed at Rotem Amfert Negev crushing plant

The solution

Vortex Ecological Technologies Ltd. supplied a Wet-Vortex scrubber for a dust suppression system built by Rotem in one of its primary crushing plants.

Total amount of solid particles entrained and handled by the Vortex scrubber was about 3 tones per hour (much above originally estimated) comprised of:

- 7% of the solids are in size of less than 1 micron (about 200 Kg per Hr),
- 35% of the solids are in size of less than 10 micron (about 1000 Kg per Hr).

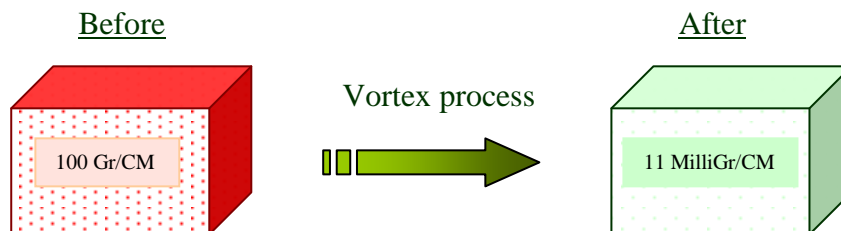
The solid concentration in the circulating liquid (water) is approximately 30% and far above originally planned.

Actual flow rate of air through Vortex is about 35,000 cubic meter per Hr.

Solid concentration at Vortex inlet is about 100 gram per cubic meter air.

Maximal allowed rate of solid particles in the flue gases is 50 milligram per cubic meter air.

Solid concentration at the Wet-Vortex outlet, as was measured by independent certified lab is about **11 milligram per cubic air, which is 99.9% collection efficiency.**



Measurements method.

Evaluation of the collection efficiency was done by measuring of dust concentration at inlet and outlet of the Wet-Vortex cleaning equipment. Knowing these concentrations, the cleaning efficiency, E , was calculated by the following formula:

$$E = \frac{m_{in} - m_{out}}{m_{in}}$$

Where m_{in} and m_{out} are the mass concentrations of dust in air at the inlet and outlet respectively. The mass concentration in the outlet stream was measured according to the demands of the EPA 17. Principal scheme of this method is presented on Fig.1.

Mass concentration in inlet stream was calculated from solid content and flow rate at blow-down stream of circulated scrubbing water.

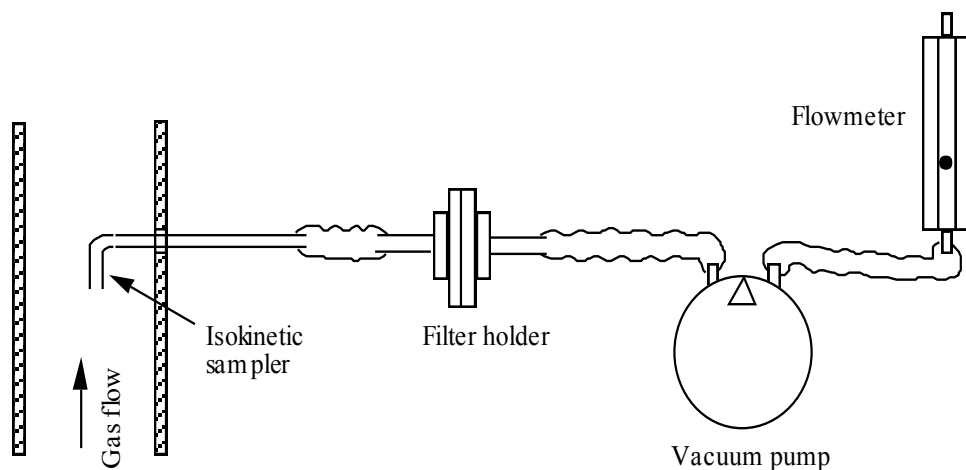


Fig 1: Principal scheme of the measurement according to the EPA 17

In Rotem's case:

$$E = (3000 \text{ kg/h} - 0.36 \text{ kg/h})/3000 \text{ kg/h} = 0.9988 \rightarrow 99.9\%$$

Further to the overall collection efficiency, it is important to notice the excellent sub-micron particles collection efficiency:

$$E(\text{sub-micron}) = (200 \text{ kg/h} - 0.36 \text{ kg/h})/200 \text{ kg/h} = 0.9982 \rightarrow 99.82\%$$

Test Results with Vortex Scrubber carried out by Ecology Laboratories A.P. Ltd.

Dep-t 70. Vortex Stack, 2 series - PM. 22/09/2009. Technology.

Sampling Series	Average Stack Gas Temp °C	Stack Gas Water Content %vol	Average Stack Gas Velocity m/sec	Average Stack Gas Flowrate (Stack Cond-s) acm/Hr	Average Stack Gas Flowrate (St-d Cond-s 20 °C) dacm/Hr	Sampling Time HH:mm	Hazard Sampled	Hazard Instack Conc-n (St-d Cond-s 20 °C) mg/dscm	Hazard Emission Rate Kg/Hour
Series 1	29.3	2.5	15.5	35,525	31,906	13:12-13:40	PM	10.3	0.3295
Series 2	29	2.6	15.5	35,414	31,835	13:47-14:15	PM	11.5	0.3671

Remarks: 1. The Concentrations were Calculated at Standard Conditions (Dry Gas, 20 °C, Atmospheric Pressure)
2. "< LOD" = less than the Limit of Determination.

Abbreviations:

St-d = Standard

Hazard = Solid particles

Conc-n = Concentration

Cond-s = Conditions

About Vortex Ecological Technologies:

Established in 1996, Israel Vortex Ecological Technologies develops industrial pollution control systems that clean industrial emissions and industrial liquids flow from fine particles and gas pollutants in a scalable and cost-effective manner. The company operates globally and successfully deployed its products with prestigious customers.

Vortex's patented technology manipulates the physical forces created by a high velocity vortex motion of either gas or liquid inside a Vortex proprietary chamber to separate fine particles from a gas or liquid flow. The force-pattern separates fine particles from the gas or liquid by pushing the particles to the center of the chamber without wear or clogging

risks. This results in efficient separation performances and lower operational and maintenance costs. The company headquartered in Haifa, Israel.

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