Simulation and Optimization of the Speed Flow in COMSOL Multiphysics during the Suction of the Dust Pump for Granite Polishing Operation

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Introduction: Polishing process of granite produced hazard and dust with high concentrations. The measurement of those high concentration by TSI air quality devices (SMPS, APS, Dusttrak,…) was difficult. To facilitate the measurement by the chamber dilution system, our work aim to optimize speed flow of suction pump for dust injection.

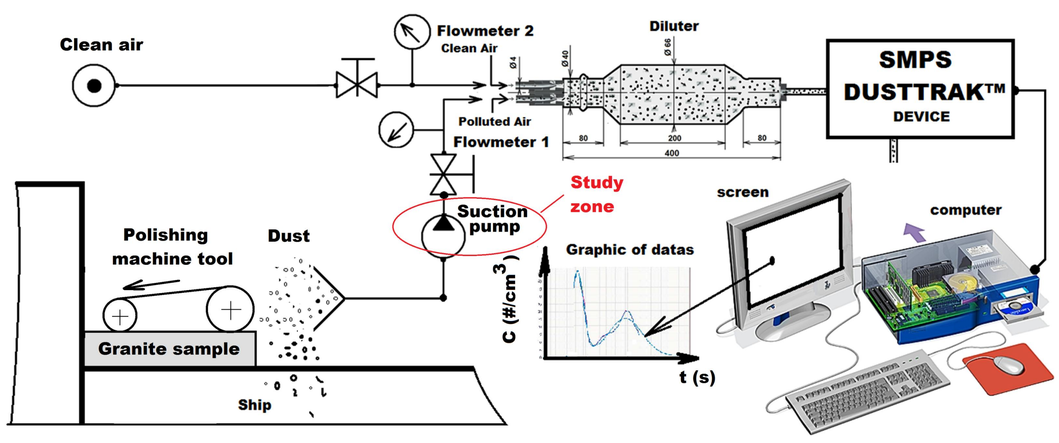

Figure 1. Experimental setup.

Computational Methods: We used the NAVIER-STOKES equations, CFD k-ε model to obtain the graphic simulation and optimization of the pressure on the blade during the pumping process.

$$\frac{\partial \rho k}{\partial t}+\frac{\partial \rho k u_i}{\partial x_i}=+\frac{\partial}{\partial x_j}\left[\left(\mu+\frac{\mu_t}{\sigma_k}\right)\frac{\partial k}{\partial x_j}\right]+G_k+G_b-\rho\varepsilon-Y_M+S_k$$

$$\frac{\partial \rho \varepsilon}{\partial t}+\frac{\partial \rho \varepsilon u_i}{\partial x_i}=+\frac{\partial}{\partial x_j}\left[\left(\mu+\frac{\mu_t}{\sigma_k}\right)\frac{\partial \varepsilon}{\partial x_j}\right]+C_{1\varepsilon}\frac{\varepsilon}{k}\left(G_k+C_{3\varepsilon}G_b\right)-C_{3\varepsilon}G_b-C_{2\varepsilon}\rho\frac{\varepsilon^2}{k}+S_\varepsilon$$

The blade pump which sucked the polluted air was described in the figure2.

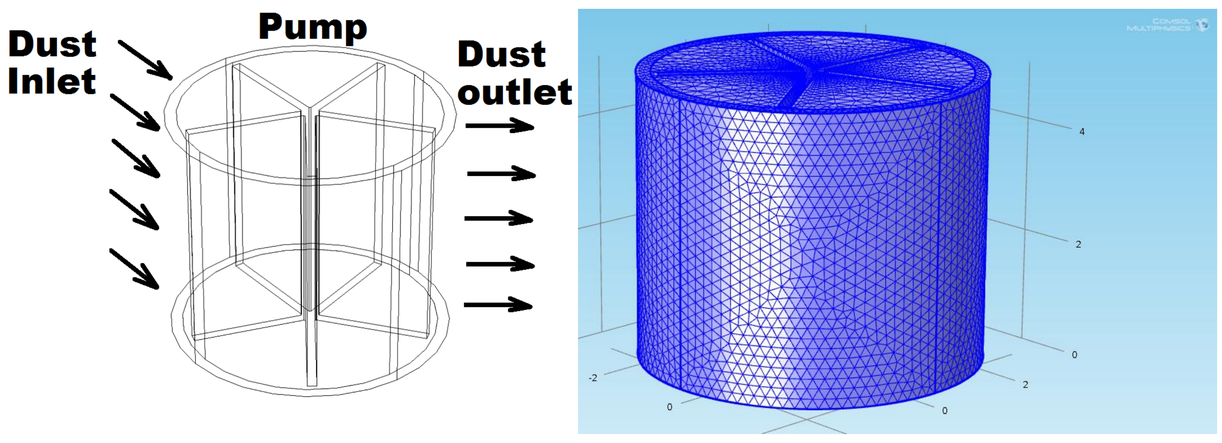

Figure 2. Domain of Palette suction pump and meshing.

Results: the best result in concentration measurement in the diluter was obtained when the inlet flow velocities varied between 0.2 to 1.5 m/s (Figure 3 and 4).

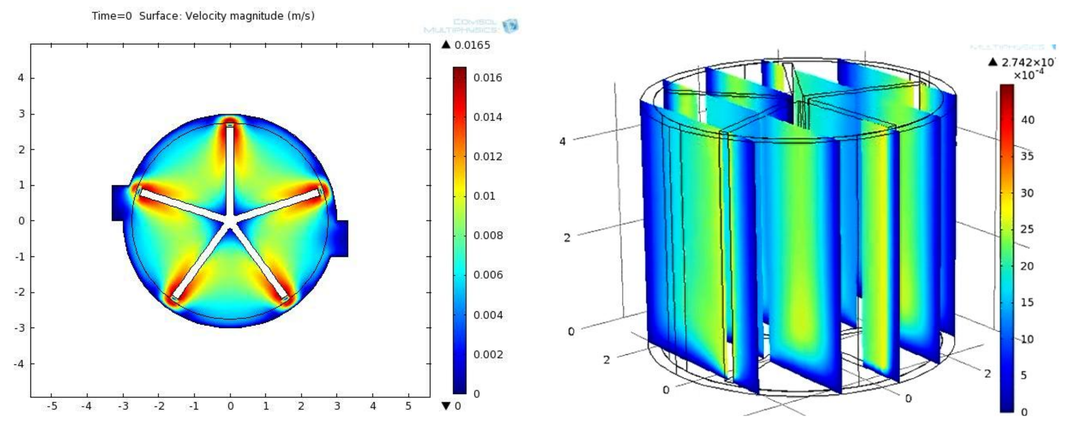

Figure 3. 2D and 3D simulation of average velocity field.

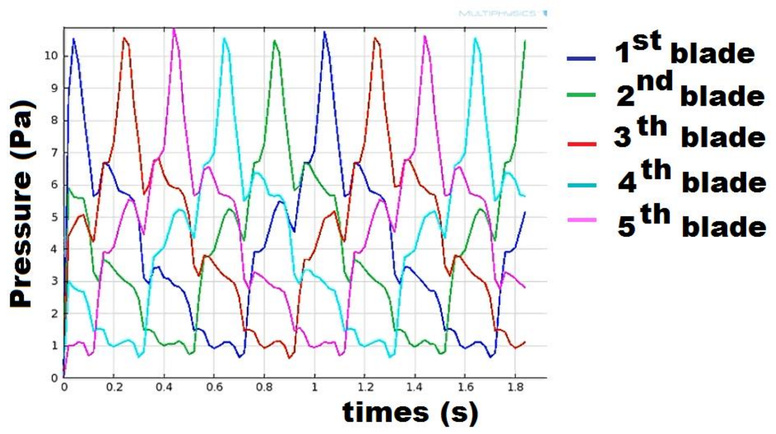

Figure 4. Average pressure on the blade.

Conclusions: For the five blade the pressure was low than 10 Pa during two seconds of simulation in Comsol Multiphysics. This pressure had the good agreement with dust behavior in the air during sucking. With the obtained pressure, dust conserved their mobility diameter during the injection in the diluter.

References:

1. Djebara, Wenga, and Songmene, Pollutant Emissions control in the Machine Shops, EHS-02 (2012).
2. Wenga & al, (2012), Numerical study and simulation of dust sampling with dilution, Encyclopedic of research in Aluminium (2012).

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