8th. World Congress on Computational Mechanics (WCCM8)
5th. European Congress on Computational Methods in Applied Sciences and Engineering (ECCOMAS 2008)
June 30 – July 5, 2008
Venice, Italy

Validation of an experimental model of the air flow over a conveyor belt. Implications on dust emission.

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Key Words: *CFD, conveyor belt, dust emission, experimental fluid dynamics.*

ABSTRACT

In the framework of the Research Project CTM2005-00187/TECNO, "Prediction models and prevention systems in the particle atmospheric contamination in an industrial environment" of the Spanish National R+D Plan of the Ministry of Education and Science, 2004-2007 period, there have been developed several experimental tests and CFD models to simulate particulated material emission from conveyor belts.

PM10 or PM50 material can be easily thrown in suspension from the conveyors, creating an environmental problem not only in the vicinity of installations but also at long distances from the particle source. In case of open air stockage yards one of the ways to establish the amount of the particle emission is the use of US EPA regulations [1], implemented by the authors in previous studies using commercial CFD (Computational Fluid Mechanics) code Ansys CFX, see [2] and [3]. Now this knowledge is used to establish the amount of dust leaving the hill-shaped material over the conveyor belt.

An experimental setup was installed in the storage area of an underground coal mine, manufacturing a complete section of a conveyor belt 600 mm wide and 6 meters long. The blowing air was simulated using a mine ventilation fan powered by compressed air, reaching air velocities as high as 14 m/s measured using hot-wire anemometers, and where dust emission was effectively observed and measured using light-scattering instruments. A CFD model was created and validated against this full scale model, see Figure 1, in order to calculate wind velocities around the material. There were selected medium complexity turbulence models in order to obtain affordable resolution times in single processor machines, as well as following advices contained in related bibliography, [4] and [5] among others. The calculated values of the air velocity show good agreement with the measured ones as can be seen in correlation graphic at Figure 2. These good results are being used as a base of the multiphase CFD calculations that will be compared with the light scattering dust measurement equipment.

The authors wish to thank the invaluable help and advices given by the management and working teams at Carbonar, the coal mine where experimental tests were done.

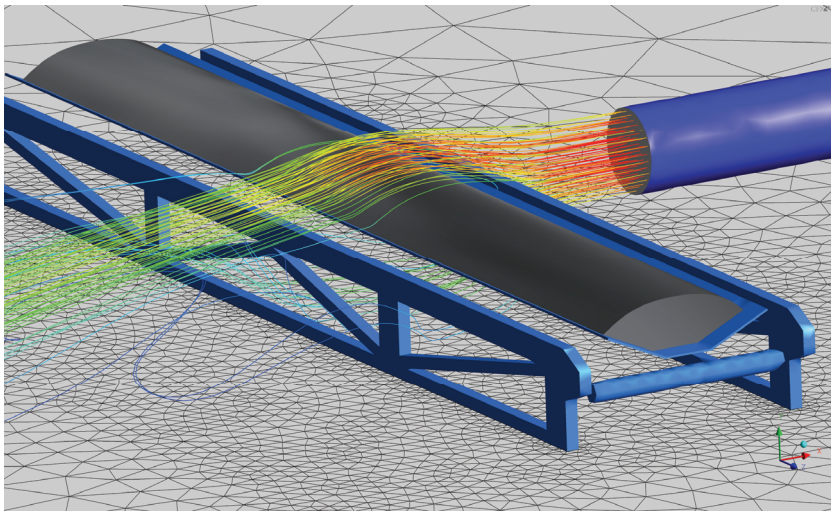

Figure 1: CFD Model. Air streamlines coloured according to velocity magnitude.

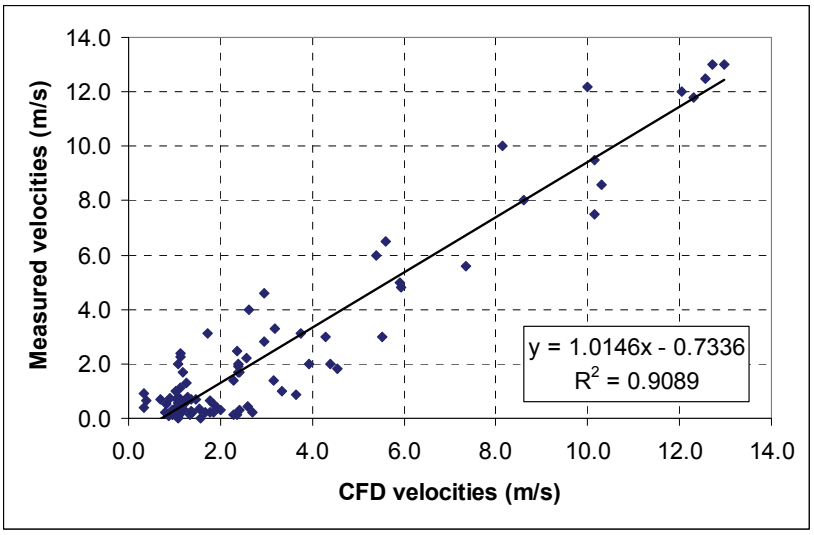

Figure 2: Comparison between measurements and CFD calculations

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