CASE STUDY

Filter Flow Modelling

Task

The filter device was put in operation to treat air containing dust. During operation, uneven wear of the filter inserts and sheet metal casing was detected. The task was to find out why the wear occurs and whether it is possible to prevent the early failure of the filter cartridges.

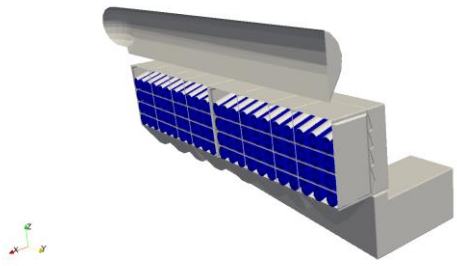

Fig.1 Computational Model

Methodology

The geometric model consists of an inlet piece, the bodies of two side-by-side filters, filter cartridges and a collector with a discharge piece. The body of the filter is modelled as a two-space cabinet: a space for separating dust with filter carteridges and a collector space for clean air.

Filter cartridges influence on flow, i.e. pressure loss, is taken into account using the Darcy-Forchheimer formula for the flow in a porous body.

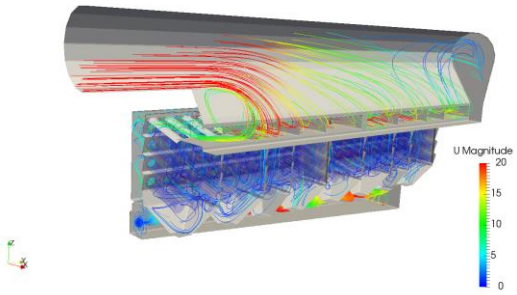

Fig.2 Velocity Streamlines

Flow is modelled as steady state, incompressible and turbulent.

Results

The calculation of the existing geometry showed high flow velocities in the places of the most damaged filter cartridges. The abrasive effect of the high velocity dust particles in these places, shortened the lifetime of the filter cartidges significantly.

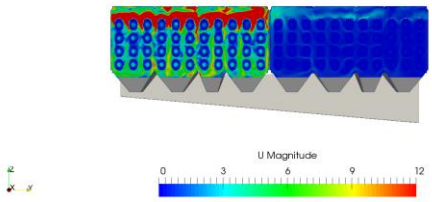

Fig.3 Non-uniform Filter Load

The obtained results were used to design a new inlet duct in the next step. The layout of the facility did not allow a change leading to a major reduction of the inlet velocity magnitude. However, it was possible to design a geometry minimizing the uneven distribution of the air stream on both filters.

Relatively high velocities occur mainly in the upper parts of the filters, near the walls and the highest row of filter cartridges. The protective sheets of the upper row of the cartridges accelerate the flow and direct it to the lower rows of cartridges. In these places - if the design is not modified - increased wear can be expected.

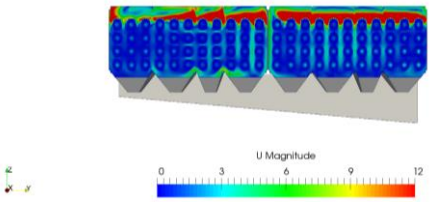

Fig.4 Filter Load Modification