Take AIM

Smith institute
for industrial mathematics and system engineering

Modelling removal of harmful chemicals from flue gas

TakeAIM Winner 2017:
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In the drive to protect the environment, reducing the concentrations of harmful chemicals that are released into the atmosphere has become a priority for industries. One key example is the removal of sulphur dioxide from flue gas.

In order to achieve this a filtering procedure needs to be implemented. However, most existing methods, such as “gas scrubbing”, require high input power and a specifically suited operation site.

My research project focuses on a more desirable and cost-effective method of removal of sulphur dioxide: flue gas flows through stacks of parallel open channels and diffuses into their porous surface, where a chemical reaction takes place and converts sulphur dioxide into liquid sulphuric acid. This method requires very low input power, does not need a special operation site (can be installed anywhere along the path of the gas stream), and also generates sulphuric acid “for free”. However, these filters exhibit one main problem: as liquid sulphuric acid accumulates, it gradually blocks the filter and limits its subsequent efficiency.

We are developing a multi-scale mathematical model that couples an understanding of how liquid sulphuric acid evolves on the microscale with a device-scale model to predict the global filter properties such as its efficiency over time. The result of our model will provide essential understanding of the process to our collaborators at W. L. Gore and Associates, which will inform the future design of their filters to maximise their lifetime. Furthermore, the model is general enough to be applied to other gases and impurities.

The Smith Institute, enabled by the generous sponsorship of our leading corporate partners, ran the TakeAIM competition in 2017 to make visible the crucial role that mathematics will increasingly play in all aspects of our lives. The competition was open to undergraduate and postgraduate students working in the mathematical sciences. First prize was £1,250 of Apple vouchers, second prize £500 of Apple vouchers and six runners-up each received £150 of Amazon vouchers.