Separation and Removal of Metal Spall Particulates from a High-Purity Process Gas Stream

Overview
Due to the extreme process conditions, a condition known as metal spalling is occurring in a gas production technology. Metal spalling is defined as a process that occurs when flakes are separated from a larger metal body. In this high purity application, the presence of particulates ranging from 5 to 100 microns introduces unwanted contaminants, which could potentially damage downstream components.

Objectives
- Design a solution that can collect and remove at least 80% of metal spall particulates greater than five microns from a gas stream at high temperatures and pressures
- Construct a prototype and test the effectiveness of the design at ambient temperature and pressure using air as the gas flow stream
- Develop a theoretical or computational model of the gas flow and particle removal dynamics, correlate with the test data and use the model to predict the performance of the design at actual process conditions

Approach
- Literature and Patent review of existing separation processes/products
- Trip to Air Products facility in Allentown, PA to gather specific process details
- Customer needs matrix developed
- Concept screening matrix was developed
- Solidworks 3D models were developed for initial designs
- ANSYS Fluent was used to computationally model the gas flow and particle dynamics
- Prototype design was developed with Solidworks
- Prototype was built using materials purchased from McMaster-Carr and Lowes
- Testing was done at ambient conditions
- ANSYS Fluent was used to computationally model the gas flow and particle dynamics of prototype
- Test data and modelling were correlated to ensure accuracy of the results
- Statistical analysis of results was performed

Outcomes
- Device will remove at least the minimum threshold set by Air Products
- Device will reduce the downtime on site due to spall particulate build up at current downstream filter
- Pressure drop across the device is uncertain, and will need to be examined further
- It is currently unclear what the overall effect on the cost savings from implementation of the device