Accepted Manuscript

Estimation of particle impact based erosion using a coupled direct particle — Compressible gas computational fluid dynamics model

L.A. Florio

PII: S0032-5910(16)30657-X
DOI: doi: 10.1016/j.powtec.2016.09.074
Reference: PTEC 11984

To appear in: *Powder Technology*

Received date: 14 March 2016
Revised date: 25 August 2016
Accepted date: 27 September 2016

Please cite this article as: L.A. Florio, Estimation of particle impact based erosion using a coupled direct particle — Compressible gas computational fluid dynamics model, *Powder Technology* (2016), doi: 10.1016/j.powtec.2016.09.074

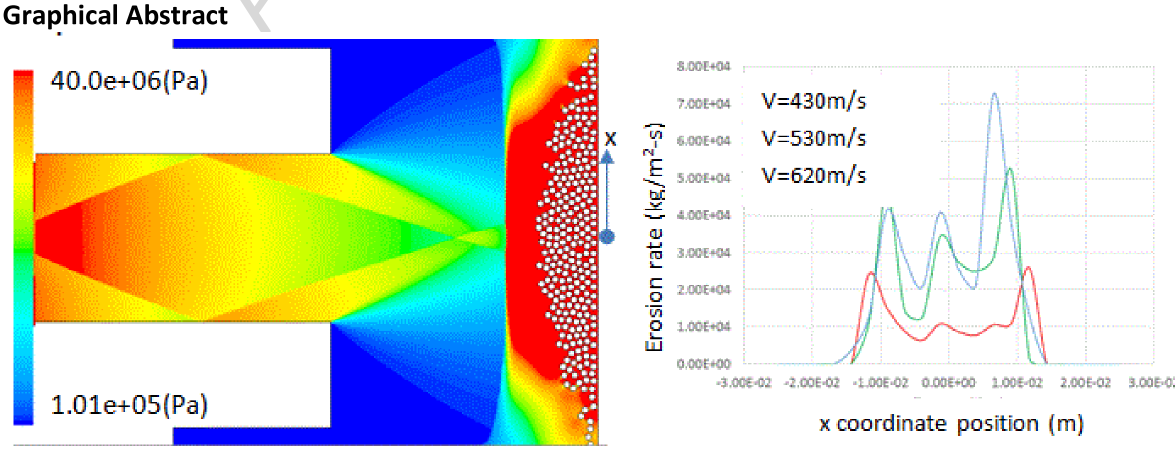
Estimation of particle impact based erosion using a coupled direct particle – compressible gas computational fluid dynamics model

L.A. Florio
US Army ARDEC
Technology Branch
Small Caliber Armaments Division
Picatinny Arsenal, NJ 07806
Phone:(973)724-5993
Fax: (973) 724-2419
Email:laurie.a.florio.civ@mail.mil

Abstract:

A comprehensive two-phase compressible gas-solid particle computational fluid dynamics-based modeling method has been developed and applied to study the erosion and fouling along flow path surfaces due to particle impact. Extending upon methods to predict particle interaction phenomena which incorporate rolling, twisting, sliding, and adhesion forces to capture conditions that frequently occur as particle laden flow passes over a flow path surface, the simulation methods have been specifically designed for high particle concentrations and large particle sizes. In the developed technique, individual particles are directly discretized in the computational mesh, and the particles move through the fluid, and interact with the flow, flow path boundaries, and other particles. With particle motion calculated from the direct two-phase flow simulations, the distribution and intensity of the mass loss or erosion conditions along a flow path surface resulting from particle impact is predicted. The developed method was applied to study the erosion of an aluminum wall due to impacting sand particles of different sizes, impact velocities, and counts. A more fluid-like particle motion and distribution upon impact were found as the particle size decreased. The method was also implemented to examine the erosion that develops for three common flow configurations which force particle-flow path surface interactions: a diverging/converging flow path, a bypass flow path, and a baffle configuration. These applications demonstrate the utility of the model to explore and better understand the relationships between the geometry, the flow, the particles, and the adhesion and erosion that develop as particle laden flow moves over the flow path surfaces.

Graphical Abstract



Pressure distribution as particles impact   Erosion rate distribution along impact surface

Flow driven particles impacting a normal plate