

The Dusty Gas Model

The 'Dusty Gas Model' is a theory which describes the transport of gases through porous media. It is so called because it treats the porous medium as a component of the gas mixture, consisting of giant molecules, like dust in a gas. Transport equations for the gas through the porous media are derived by applying the kinetic theory of gases to this 'supermixture' of free gas and fixed in space solid molecules. The model has been independently developed at least four times, starting with J.C. Maxwell in 1860; and can be adapted for modelling other phenomena such as aerosol motion (by allowing the solid molecules to move).

The model incorporates three of the four modes of transport found in porous media:

Free-Molecule or Knudsen Flow (D_K), in which the gas density is so low that collisions between gas molecules can be ignored compared to collisions of gas molecules with the porous medium walls.

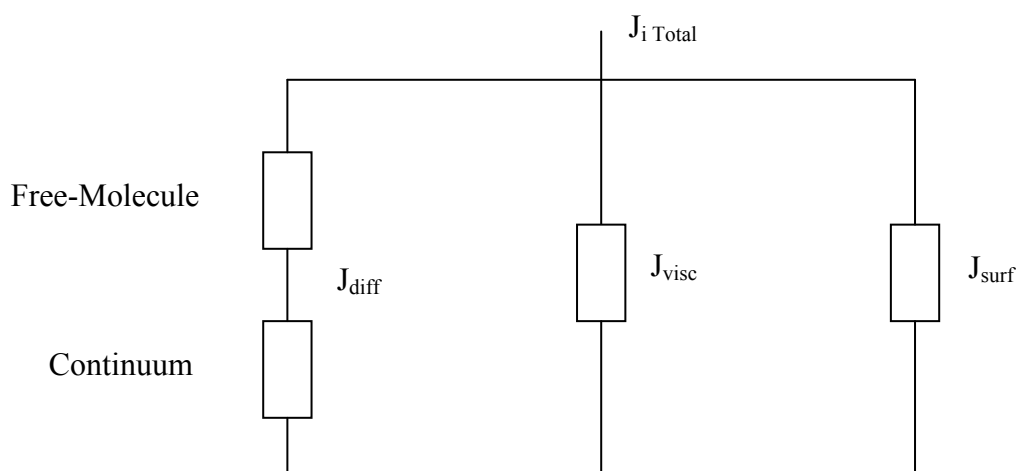
Viscous or Convective or Bulk Flow (η), in which the gas acts as a continuum fluid driven by a pressure gradient, and gas-gas collisions dominate over gas-wall collisions.

Ordinary or Continuum Diffusion, in which the different species of a mixture move relative to each other under the influence of concentration gradients (concentration diffusion), or external forces (forced diffusion) (together D_{ij}), thermal gradients (thermal diffusion) (α_{ij}). Here gas-gas collisions also dominate over gas-wall collisions.

The fourth mode, *Surface Flow or Diffusion (D_{is})*, in which molecules move along a solid surface in an adsorbed layer, is assumed to be independent of the preceding mechanisms. This mechanism can be included in calculations but is added independently, and as it is less frequently of significance, it is omitted from the basic analysis.

Incomplete !!!

These four mechanisms can be combined in a similar manner (but NOT algebraically the same) to that used to analyse electrical resistor networks



References:

E.A. Mason & A.P. Malinauskas, Gas Transport in Porous Media: The Dusty-Gas Model, Elsevier, 1983.

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