Take Home Exam 02: SSA

Assigned: 08/24/2022

Due (as pdf by email) 08/28/2022 (Sunday)

•you will receive a simple letter grade for your report

•You may submit your answers in one of two ways:

1) For typed answers: as a .docx file (as is) or converted into a pdf file. (DO NOT SEND GOOGLE DOC)

For handwritten answers: Please scan as images, and group together into one pdf file. Or you may hand them manually to my office (ECME-212)

HW 02.1

Write a one-half-page essay to discuss the application of the results obtained during today's lecture:

$$SSA = \frac{6v_f}{d\rho\left(1-v_f\right)} \qquad \text{(Eq. 1)}$$

which was derived for isolated spherical pores placed periodically in a cubic lattice (one pore per cube)

Real-life applications, however, reach beyong the once pore per cube assumption in the following ways:

i. The pores may have a complex shape, for example cylindrical, and both interconnected cylindrical and spherical pores.
ii. The volume fraction of the pores can be large, up to 50%, when the pores are no longer isolated but connected to one another. This scenario is called "open porosity" that is the pores have access to the environment. In time release drug delivery systems such open porosity is essential for the drugs to be released into the body.

Of course the equation above can be applied to the above situations, by replacing "d" by the diameter of the cylindrical pores. However, such an approach will necessarily require a cognizance of the approximations.

For example some guidance can be obtained from the following derivations from today's lecture:

Sphere

$$\frac{S}{V} = \frac{4\pi r^2}{(4/3)\pi r^3} = \frac{3}{r} = \frac{6}{d}$$

Wire

$$\frac{S}{V} = \frac{2\pi rL}{\pi r^2 L} = \frac{2}{r} = \frac{4}{d}$$

In your short essay please remark on the source of the approximations in two real-life problems described above. That is, to what extent the SSA predicted from Eq. (1) will represent the real value of the SSA. Would it differ by a factor o 1.5 or a factor of 2 etc. and why.