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INTRODUCTION

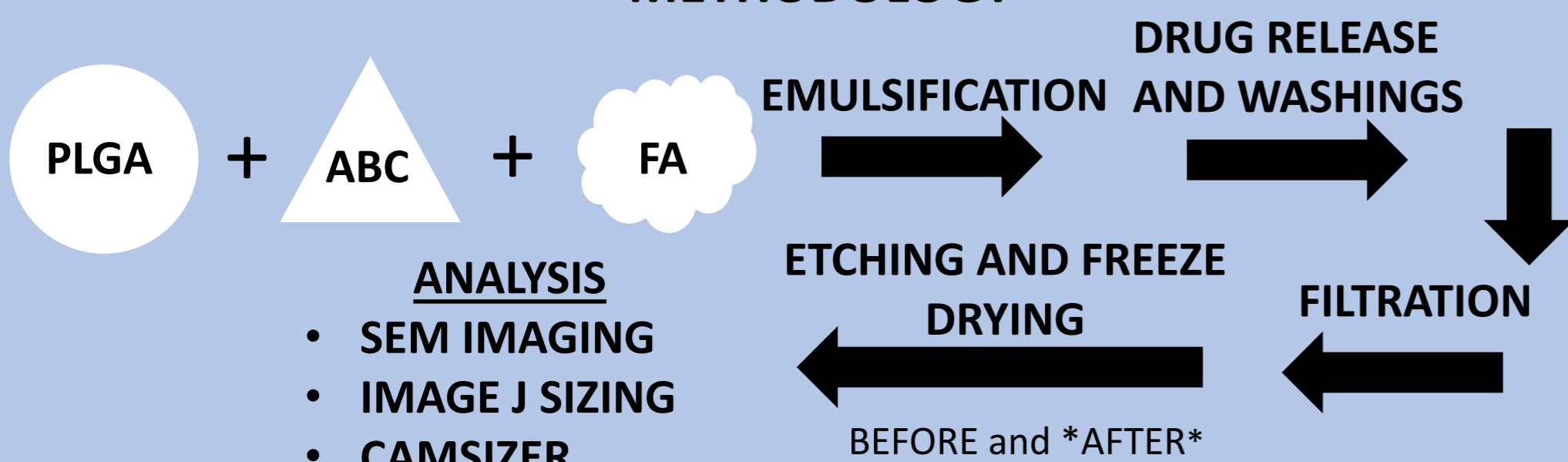
The use of microparticles is widespread as tissue modulators and drug delivery systems. More recently the focus is on the creation of injectables to make 3D scaffolds for tissue regeneration and engineering. Their biophysical and biochemical properties produce specific biological responses such as controlling cell attachment, function and fate. One important biophysical example identified by the group in previous work is the topography of the microparticle surface as this results in improved differentiation of mesenchymal stem cells and generation of osteoblasts.

One important issue is the ability to engineer human vasculature to allow transport of nutrients, oxygen and drugs within 3D tissue models. One of the key factors in developing this technology is the formation of stable porous microparticles to act as the scaffold. This topographical feature is achieved by using ammonium bicarbonate (ABC) and then etching the microparticles using ethanolic sodium hydroxide (EtNaOH).

AIMS

Investigate the effect of varying fabrication variables and optimising the etching step to increase the complexity of topographical design of microparticles. Porous microparticles will be used as a scaffold for modelling human endothelial vasculature.

METHODOLOGY



ABC %	NaOH (N)	ETCHING
7.5	0.5	EAFD
10	0.5	EAFD
2.5	1	EAFD
2.5	2	EAFD
2.5	0.5	EAFD
2.5	0.5	50% EBFD 50% EAFD

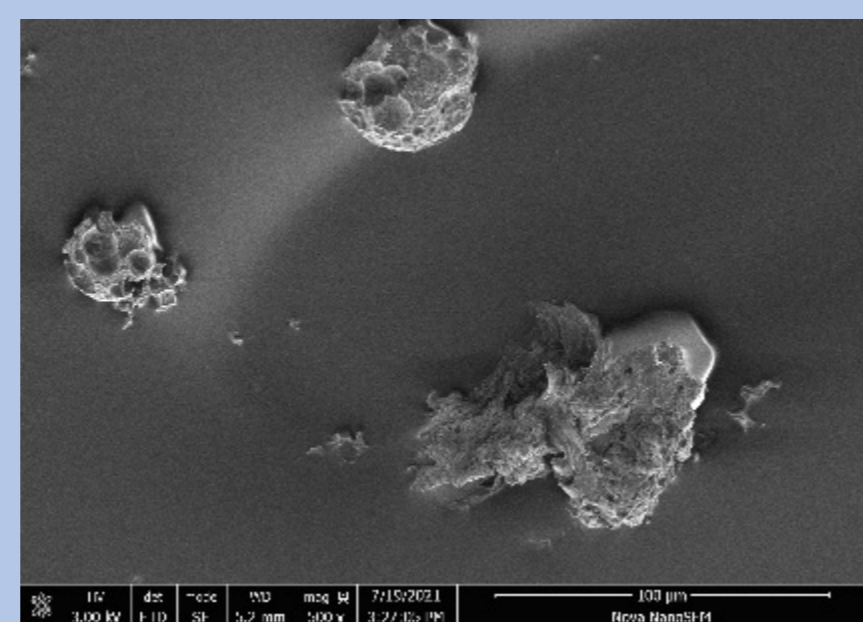
Objectives:

- Investigate effect of changing ABC%
- Investigate effect of changing NaOH conc.
- Investigate effect of etching before and after freeze drying.

EBFD = etched before freeze drying, EAFD = etched after freeze drying

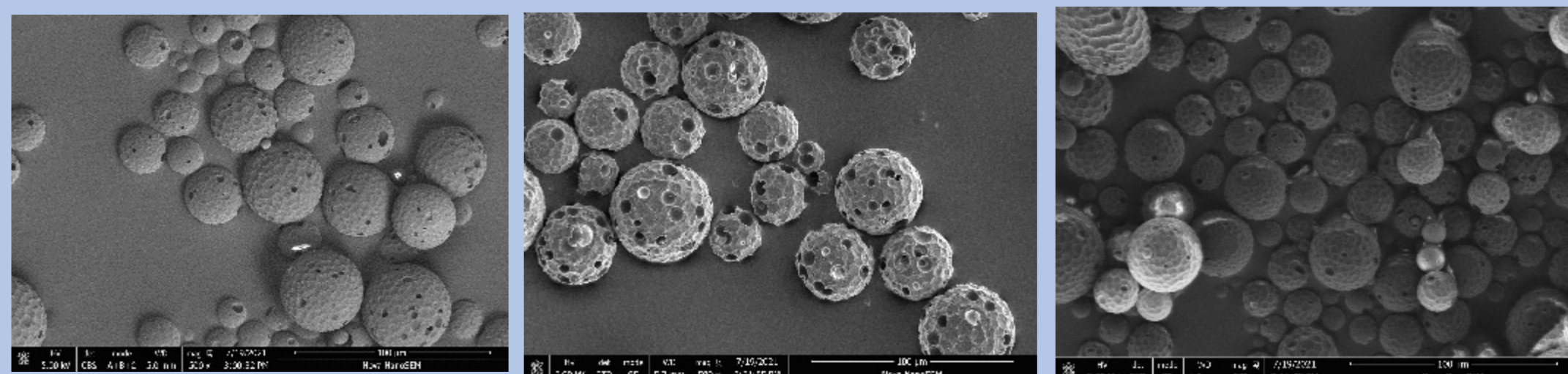
RESULTS

Variables 2A and 2B have been left out of the following results as the high NaOH concentration caused the polymer microparticles to collapse and an insignificant amount of microparticles (shown right) were left to be analysed.



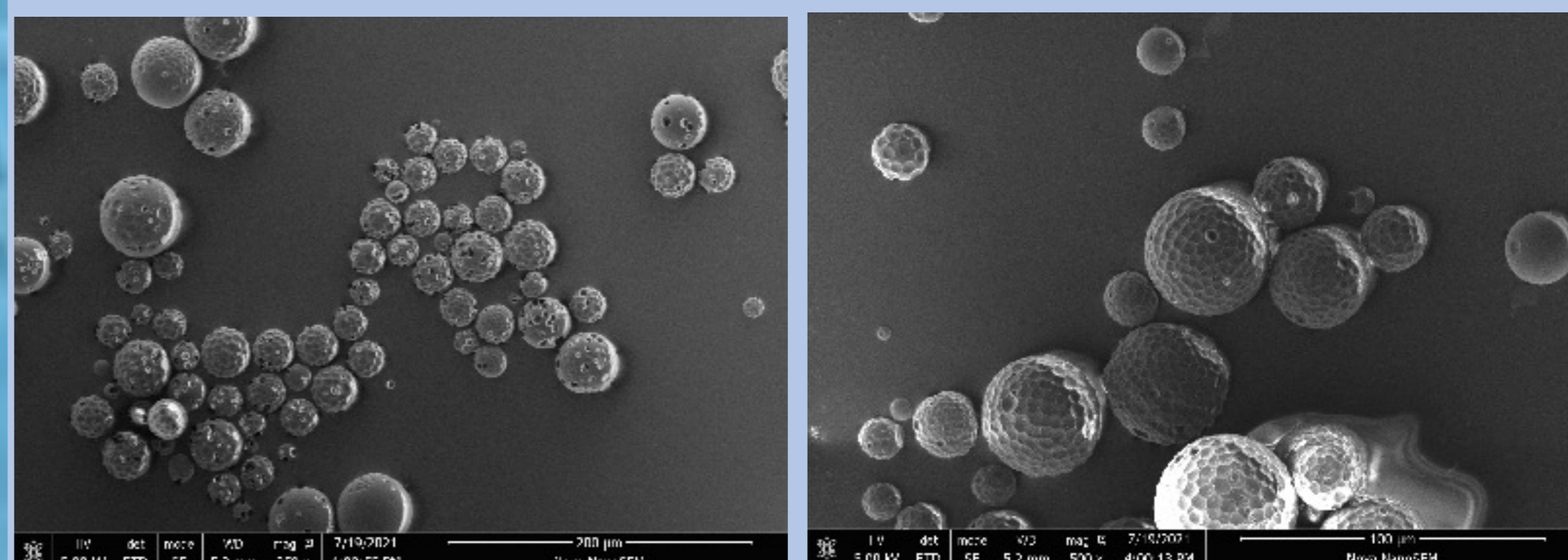
RESULTS CONTINUED

Effect of changing ABC concentration

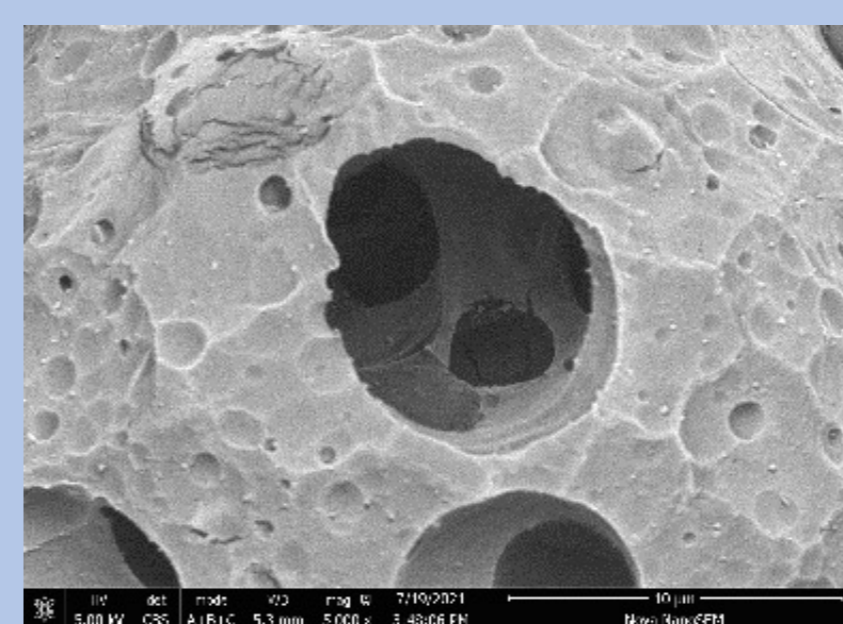


1A (left) and 1B (right) show few visible differences. Sample 3 (centre) appears to be more successful than both 1A and 1B.

Effect of etching before or after freeze drying



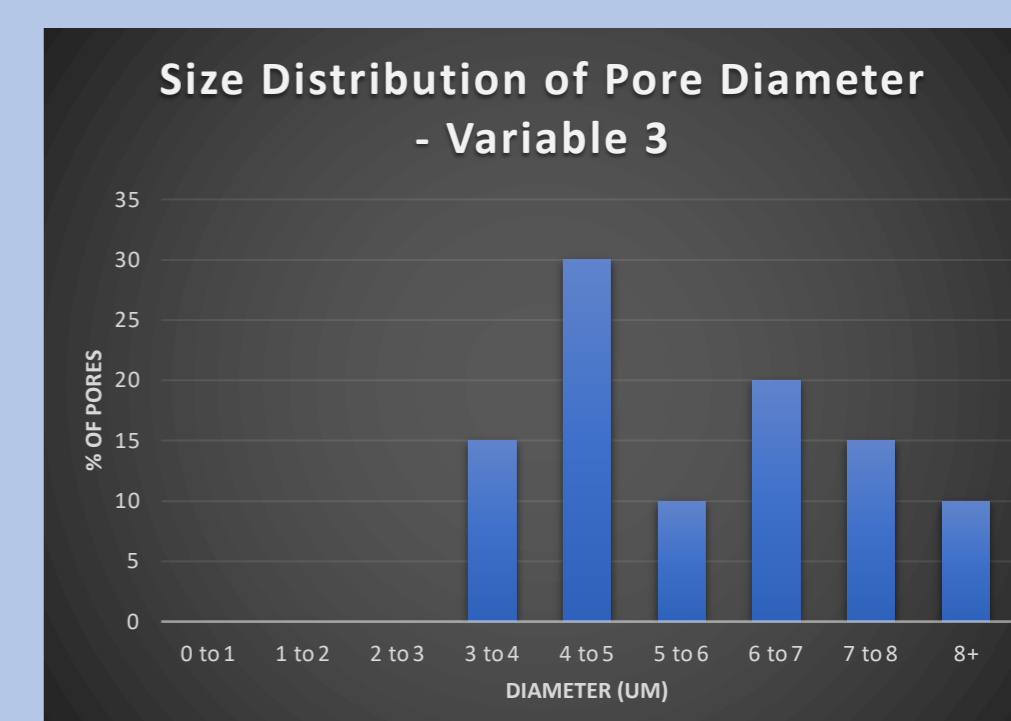
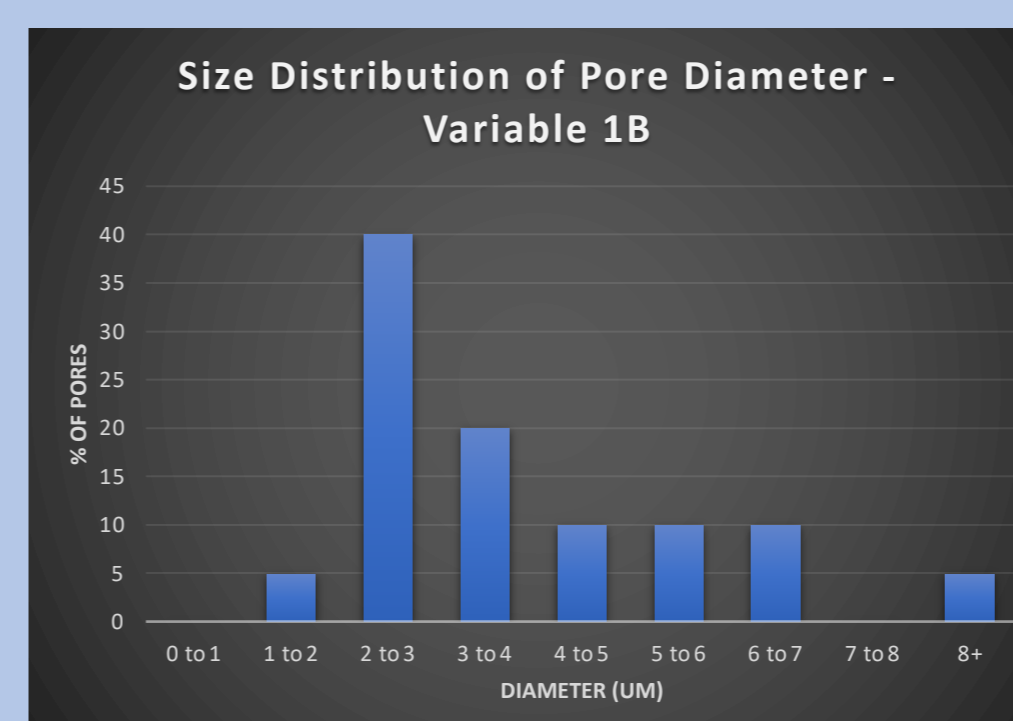
EAFD (left) shows more porosity and stability than EBFD (right). There were much fewer microparticles left in EBFD.



High Magnification Images of Pores and Dimples

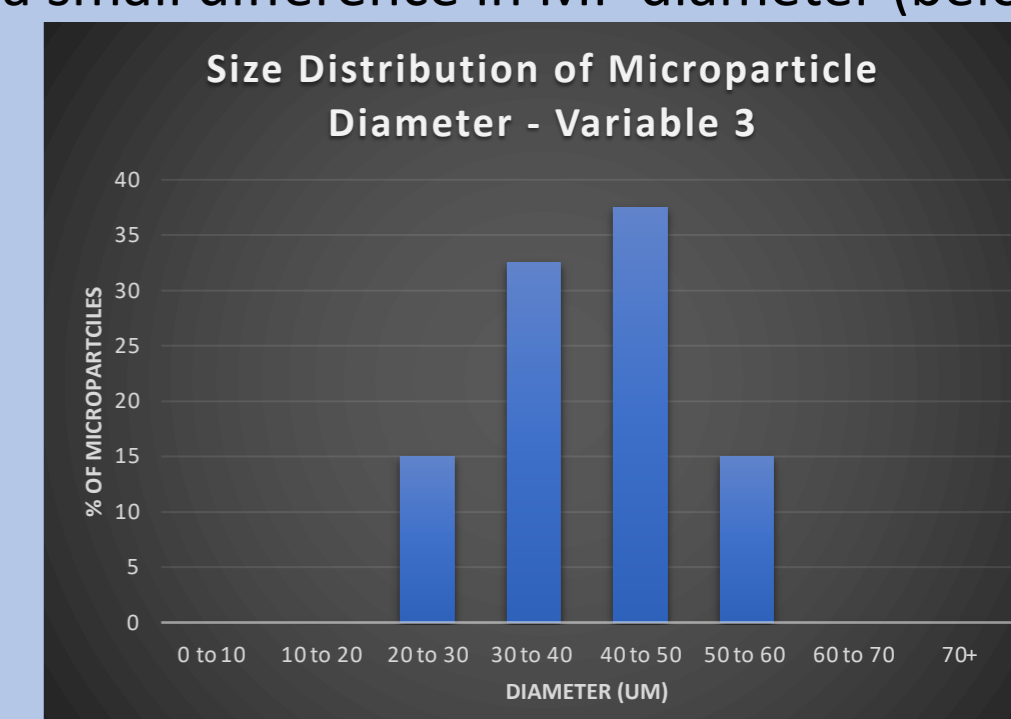
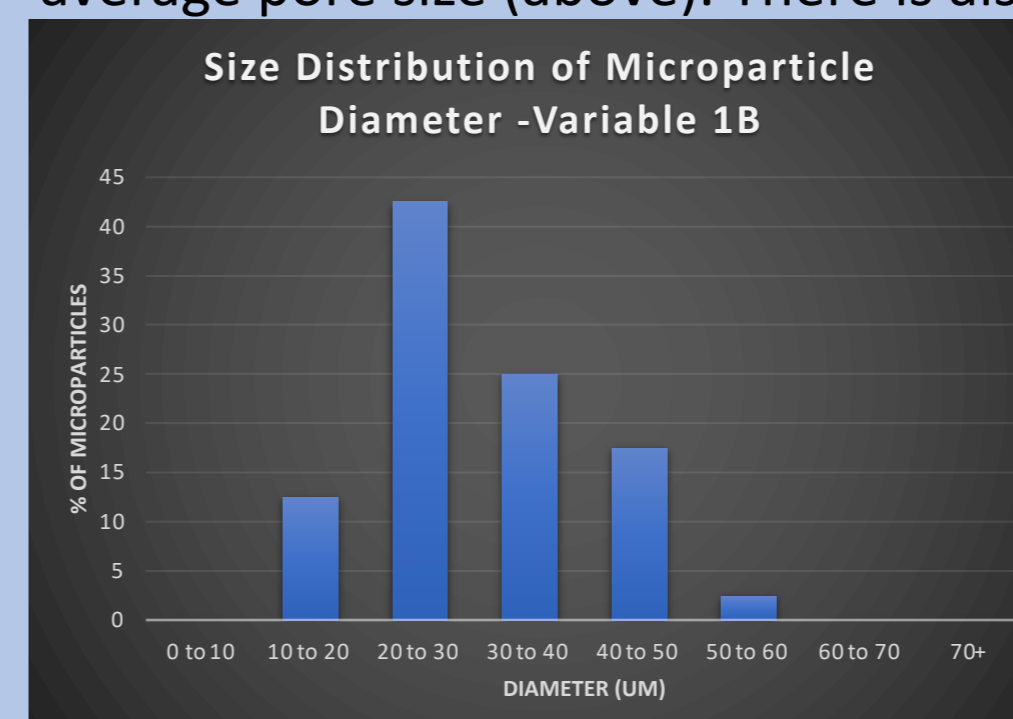


RESULTS CONTINUED



(N pores= 20)

Size distribution graphs of diameter for Variable 1B and 3 showing a difference in average pore size (above). There is also a small difference in MP diameter (below).



(N particles= 40)

CONCLUSIONS

- The effect of changing the ABC% had little effect on the appearance and pore/microparticle diameter of the resulting. The size distribution shows that the pores were on average larger in variable 3 compared to 1A so the increased ABC% has a negative effect on the pores formed.
- The effect of increasing the NaOH concentration caused the microparticles to melt and very few pores were observed. Variable 3 was etched in 0.5 N NaOH and showed pores and stability so this is the ideal etching concentration to use.
- The etching step should be done after freeze drying as particles are more stable and show porosity
- The combination of pores and dimples to make the microparticles more topographically complex was successful.