Copper samples were physically modified using sandpaper polishing. Previous work has shown that the lower the contact angle hysteresis, the higher the critical heat flux is on a boiling curve. A rough surface makes water boil faster. However, as of today the fact of bringing both concepts together to find the optimum roughness of copper has not been found yet.

Research Question/Hypothesis
The roughness of the sample drastically modifies the dynamic contact angle of the surface. The assumption is that increasing wettability will increase critical heat flux in pool boiling.

1) If the roughness of copper effects the heat flux on a boiling curve then will different contact angles effect pool boiling?

RESULTS & GRAPHICS/CHARTS

Figure 1: Roughness of the copper samples as a function of the grain size of the sandpaper. Ra represents the roughness. Rz is the difference in height between the highest and the lowest point on the sample.

Figure 2: Contact angles of the copper polished samples

Figure 3: Pool boiling curve of two samples (Grit 600 and grit 320). This curve depicts the evolution of the heat flux transferred from the surface to the fluid as a function of the superheat temperature. [1]

DISCUSSION
The results showed that it is necessary to make a compromise between boiling water at low temperature or achieve a high heat flux. Sandpaper grit 150 demonstrates faster pool boiling but a low heat flux. Due to grit 150’s high roughness, it caused the surface to have more nucleation sites (high heat transfer). As opposed to sandpaper grit 12000 which demonstrates very slow boiling but high heat flux. A surface that is polished with a 12000 grit is very smooth, mirrored like glass and has very little nucleation sites. However, this surface will allow an enhanced movement of the bubbles for to the low hysteresis in the contact angle. The contact angle and roughness of a surface is a key part to pool boiling because when bringing both concepts together to find an optimum roughness pool boiling can be improved by not wasting as much energy to get the boiling process started as well as preventing disasters from happening in nuclear power plants around the world.

REFERENCES

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