Determining the Effects of Process Parameters on Mechanical Properties in a Thin Wall FE Simulation

I plan to create 6 preliminary FE thermal simulations varying the convection coefficients, Goldak heat source efficiency, and the material conductivity properties. The convection coefficient has been seen to have a drastic effect on the thermal history and will most likely play a significant role in the resultant stress values. The efficiency controls the scale of energy density in the simulation and can provide a similar insight to fluctuating travel speed. Each parameter will be increased and decreased by 10% of the value used for the calibrated thermal model. The goal of the tests will be to determine correlations between mechanical properties found in the FE mechanical simulation and input process parameters in the FE thermal simulation. The mechanical properties to be measured will include the stresses along the longitudinal and transverse cross sections of the part. This is a preliminary study which can be added upon in the future. The table below shows the changes that will be made for each simulation. Calibrated means the original value will be used.

Design of Experiments

|  |  |  |  |
| --- | --- | --- | --- |
| Simulation # | Convection Coefficient | Efficiency | Thermal Conductivity |
| 1 | +10% | Calibrated | calibrated |
| 2 | -10% | calibrated | calibrated |
| 3 | calibrated | +10% | calibrated |
| 4 | calibrated | -10% | calibrated |
| 5 | calibrated | calibrated | +10% |
| 6 | calibrated | calibrated | -10% |

The Figure below illustrates stress values along the top surface in the transverse direction, or along the Y. This data will be used as the base for comparison until we have experimental results.

