MODELING OF FIBER REINFORCED METAL MATRIX COMPOSITE PROCESSING BY ULTRASONIC CONSOLIDATION

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MOTIVATION

To determine the optimal welding/production parameters for rapid production of fiber reinforced products

- Increased stiffness
- Increased strength
- Reduced cost

WELDING PARAMETERS

Welding parameters
-Weld speed
-Vibration amplitude
-Vibration frequency
-Applied pressure

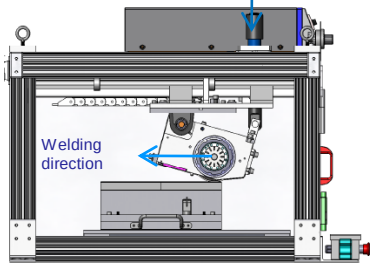
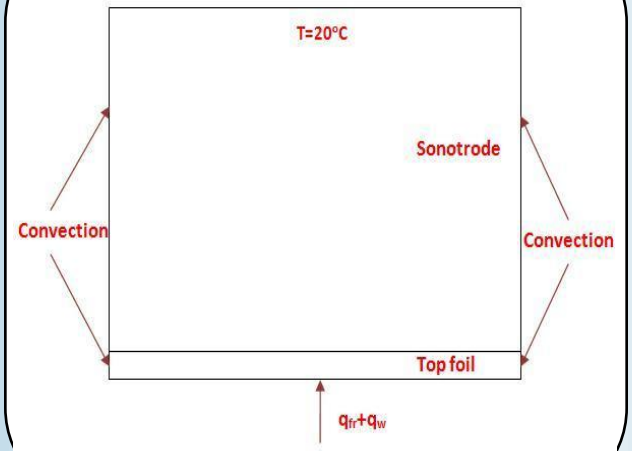


Figure:Amtech DCM01170 welder manual

THERMAL MODEL



HEAT GENERATION

By deformation

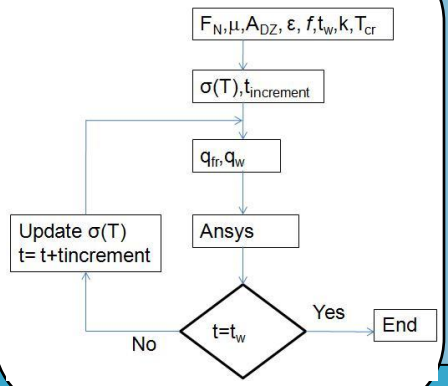
$$q_w = \frac{\sqrt{(\frac{\sigma(T)}{2})^2 - (\frac{F_N / A_{DZ}}{2})^2} * A_w(t)}{A_{DZ}} * 4 * \varepsilon_o(t) * f_w$$

By friction

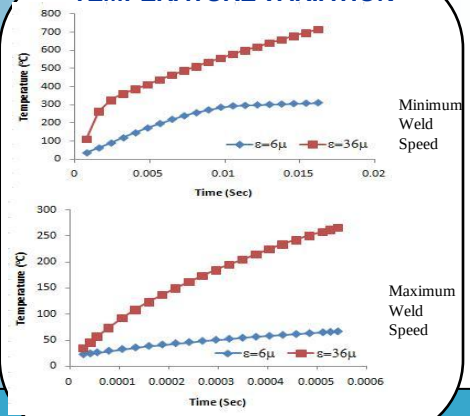
$$q_{FR} = \frac{\mu_s * F_N * 4 * \varepsilon_o(t) * f_w}{A_{FR}}$$

q_w=Deformation heat input,
q_{FR}= Frictional heat input,
s(T)=Temperature dependent yield strength
$A_w(t)$=Weld area, t=time, μ_s=Friction coeff.
F_N=Applied force, ε_o=Vibration amplitude
f_w=Frequency, A_{DZ}=Deformation zone area
A_{FR}= Frictional area

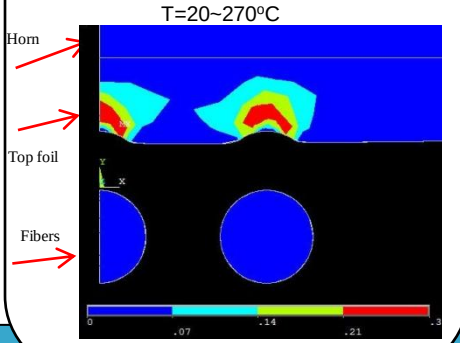
THERMAL FLOW CHART



TEMPERATURE VARIATION



RESIDUAL DEFORMATION DUE TO FIBER INTENDATION



FUTURE WORK

- IR Camera verification
- Improving the thermal model
- Residual stress formation for different weld and production parameters

ACKNOWLEDGEMENT

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