Effect Of Transverse Vibration On Tensile Properties Of Weldments

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In this paper an attempt has been made to study the effects of frequency and amplitude of transverse vibrations on yield strength, ultimate tensile strength, breaking strength and percentage of elongation of the weldments. The weldments were prepared under different vibratory conditions. The frequency and amplitude of transverse vibrations during experimentation were varied from 0 to 400 HZ and 0 um to 40 um respectively. The tensile properties of the weldemts prepared under vibratory conditions are found to have improved where as the percentage of elongation reduced when compared with the stationary welded test specimens. It has also been observed that increase in frequency of transverse vibration results in the improved tensile properties of the weldments except the percentage of elongation which descreases with increase in frequency of vibration.

A. INTRODUCTION

Recent developments and advances have given the arc welding a dominant place to shape and prepare metal parts to produce engineering structures in metal industries. In arc welding a molten pool forms on the work at the arc location. By manipulation of the electrode the molten pool is made to travel along the joint as desired. The physical and mechanical properties of fusion welds depend of course on the relative freedom of weld metal from such defects as porosity, entrapped slag, cracks and incomplete fusion, etc. These defects may be serious enough to result in the rejection of the fabricated parts. Attempts[1 to 6] have been made to reduce the defects like proposity, segregation, etc. and improve the mechanical properties by solidifying metals under vibrations. Kamath and Murthy[5] reported that columnar grain growth was suppressed and equiaxed grains were promoted under low frequency vibration solidification. Kou and Le[6] observed grain refinement and reduction of hot cracking by high frequency arc oscillation welding on aluminium alloys whereas the structure and mechanical properties of aluminium alloys were found to improve significantly by low frequency arc oscillation. The author[7] observed a reduction in the porosity and percentage of elongation of weldments prepared under vibratory conditions (40 HZ to 80 HZ). However, the improvements in the tensile strength and hardness of the weldments were not very significant.

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The influences of frequency and amplitude of transverse vibration on yield strength, ultimate tensile strength, breaking strength and percentage of elongation of welments prepared under static and vibratory conditions of welding are being discussed here. The weldments were prepared by welding mild steel plates in the frequency range of 80 HZ to 400 HZ and amplitude range of 0 um to 40 um.

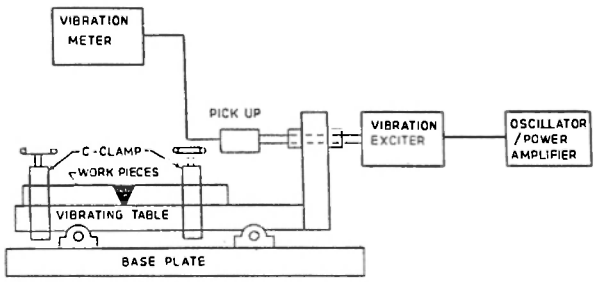

Fig. 1. Experimental set up

B. Experimental Programme

Two plates (250 mm X 250 mm X 8 mm) of mild steel were clamped on the vibrating table (Fig.1). These plates were welded under stationary and vibratory conditions. Vibrating table mounted on shafts supported on bearings was coupled to an electrodynamic vibrator. Welding was done with an A.C. welding transformer using an all position touch type mild steel electrode having rutile coating. Frequency and emplitude of transverse vibration were monitored and measured by oscillator/Power amplifier and vibration meter. Test specimens were made as

per the Indian standard specification from stationary and dynamically welded work pieces. The yield strength, ultimate tensile strength, breaking strength and percentage of elongation of these test specimens were found out on the universal testing machine.

C. Results and Discussion

Figs. 2 to 7 show the effects of frequency and amplitude of transverse vibration on the yield strength, ultimate tensile strength of transversely vibrated welded test specimens. These figures indicate that in general, the yield strength, ultimate tensile strength and breaking strength of the test specimens improve with the increase in the frequency of transverse vibration. The improvement is more pronounced in the amplitude range of 5 um to 30 um.

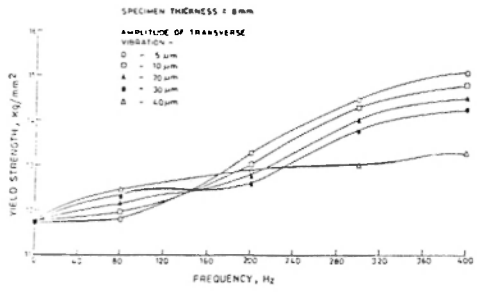

Fig. 2. Effect of Frequency on yield strength.

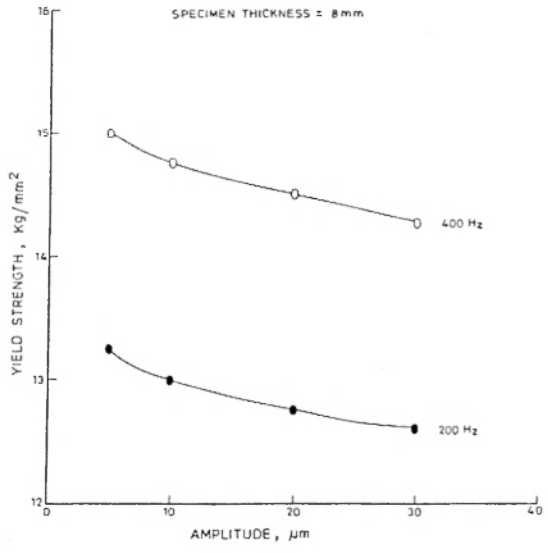

Fig. 3. Effect of amplitude on yield strength.

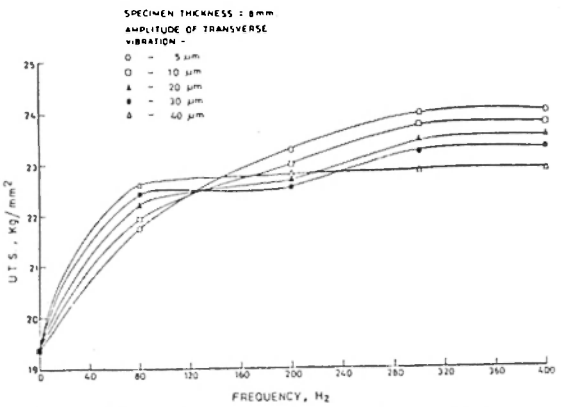

Fig. 4. Effect of Frequency on ultimate tensile strength.

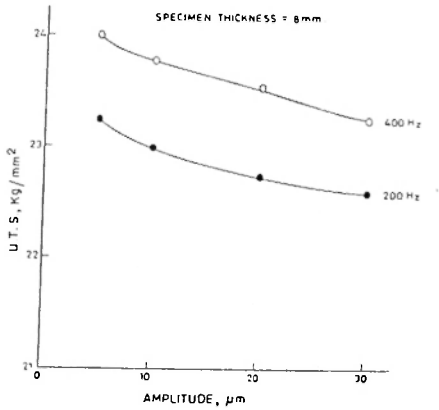

Fig. 5. Effect of amplitude on ultimate tensile strength.

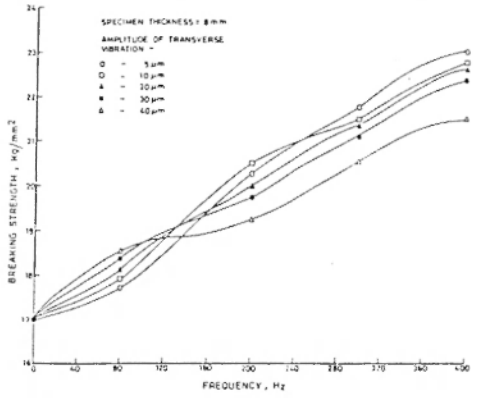

Fig. 6. Effect of Frequency on breaking strength.

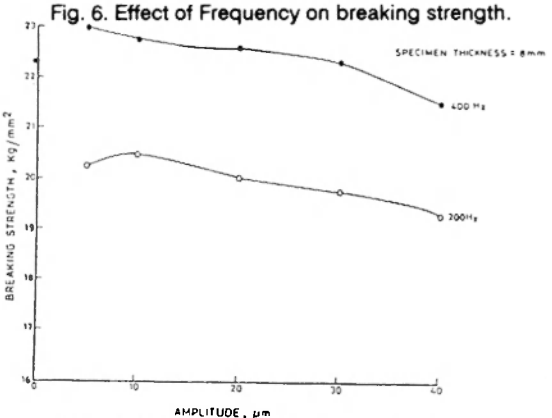

Fig. 7. Effect of amplitude on breaking strength.

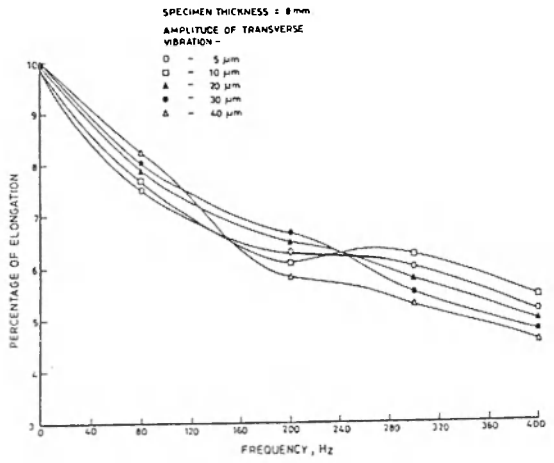

Fig. 8. Effect of Frequency on percentage of elongation.

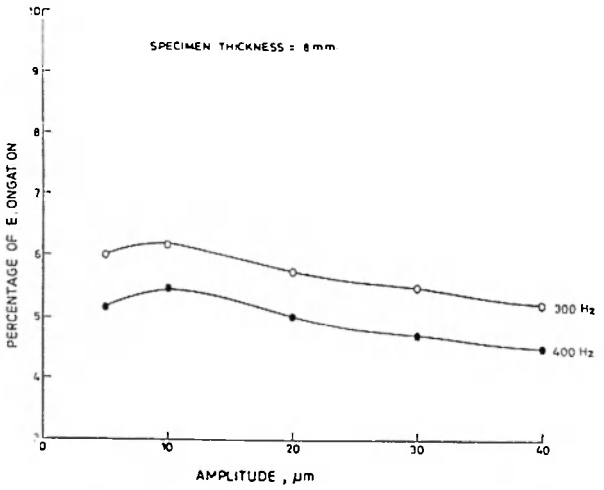

Fig. 9. Effect of Amplitude on percentage of elongation.

These figures also indicate that in the range of experiments all the strength values decrease with the increase in the amplitude of vibration for frequency of vibration lower than 80 HZ.

The effect of frequency and amplitude of vibration on the percentage of elongation of the weldments are shown in Figs.8 and 9 respectively. It can be observed from these figures that the percentage elongation decreases with the increase in frequency of vibration and amplitude of vibration. However the decrease in the percentage of alongation is more pronounced with the frequency of vibration than with amplitude of vibration. The improvement in the strength values and decrease in the percentage of elongation may be attributed to the refinement of grain size of the weldments (Fig.10 and 11) solidified under transverse vibration conditions.

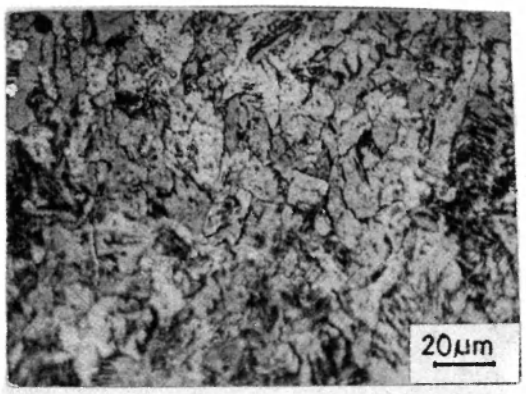

Fig. 10. Micrograph of stationary welded specimen.

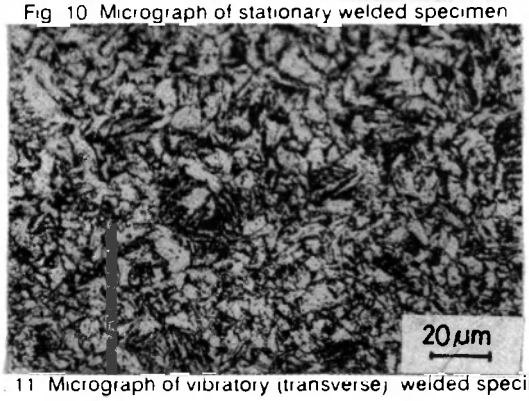

Fig. 11. Micrograph of vibratory (transverse) welded specimen.

D. CONCLUSIONS

On the basis of the experimental results, following conclusions may be derived :-

- Yield strength, ultimate tensile strength and breaking strength of the welded specimens prepared under transverse vibratory conditions showed increasing trend compared to stationary welded specimens.
- Improvement in the yield strength, ultimate tensile strength and breaking strength is significant in the frequency range of 80 HZ to 400 HZ and amplitude range of 5 um to 30 um.
- Increase in frequency and amplitude range reduces percentage of elongation of dynamically welded test specimens.

References

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