A Study of Some Factors Affecting the Cold Pressure Welding of Aluminium

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A Study of Some Factors Affecting the Cold Pressure Welding of Aluminium

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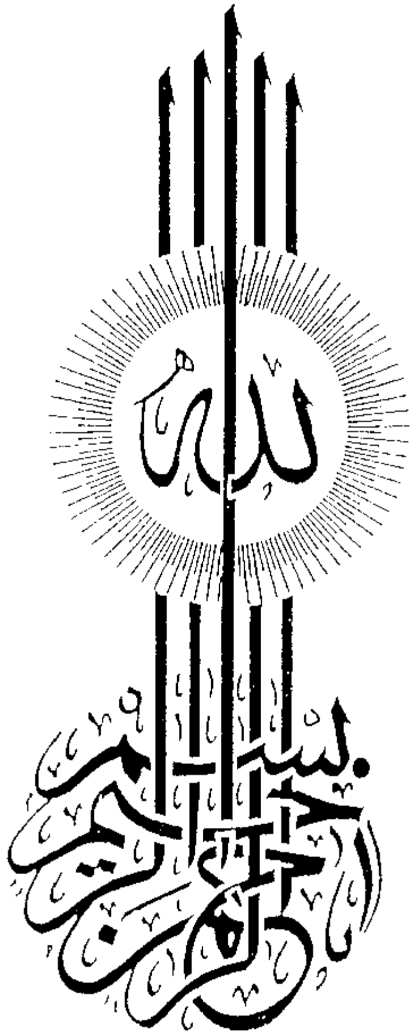
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LIST OF SYMBOLS

Symbol	Unit	Meaning
D	mm	Diameter of the flange of the butt welded joint.
d_1	mm	Nominal diameter of the specimen used.
d_o	mm	Diameter of aluminium rod before cold rolling.
d_2	mm	Diameter of tensile test specimen
F_t	kp	Tensile breaking load of the welded joint.
F_w	kp	Welding load.
F_{max}	kp	Welding load at the maximum joint strength.
t_o	mm	Initial strip thickness before rolling.
t_1	mm	Nominal strip thickness before welding.
t_2	mm	Final thickness of the lap welded joint.
Y	%	Percentage amount of oxides at the weld interface.
σ_B	kp/mm^2	Ultimate tensile strength of the base metal.

Symbol	Unit	Meaning
f	kp/mm^2	Flow stress of the base metal.
σ_w	kp/mm^2	Tensile breaking strength of the welded joint.
$\sigma_{w\,max}$	kp/mm^2	Maximum tensile strength of the welded joint.
ϕ	%	Welding deformation. $\phi = \{(D/do)^2 - 1\} \times 100$ for butt welding. $\phi = (1-(t_2/2\,t_1)) \times 100$ for lap welding.
$\phi_{\sigma max}$	%	Welding deformation at the maximum joint strength.
ϵ		Degree of prestraining of the specimen before welding. $\epsilon = 2 \ln (d_i/d_o)$ for rods. $\epsilon = \ln (t_o/t_1)$ for strips.
ψ		Reduction ratio of the specimen before welding. $\psi = \frac{\Delta d}{d_o} \times 100$ for rods. $\psi = \frac{\Delta t}{t_o} \times 100$ for strips.

A B S T R A C T

In the present work, the effect of some factors on the mechanical properties of cold pressure welds of aluminium and Al-Mg-Mn alloy was studied in both butt and lap welded Joints.

One of the studied factors is the method of surface cleaning. The results show that cleaning by chemicals only, fails to produce joints with any reliable strength, while; file cleaning gives the highest bond strength. However, surfaces can be welded if they are heated to 400°C/4 hours to ensure burning of the adsorbed surface films.

The elapsed time from surface cleaning to welding moment is found to have no effect in the interval from one minute to 570 hours, upon the joint strength, provided that the surfaces after cleaning are kept clean untouched, and stored away from any dust or organic film contamination.

A part of the work is utilized to investigate a new technique of lap welding, in which, higher joint strength can be achieved with lower welding loads and deformations by inducing a relative motion between the faying surfaces. This motion can be induced either manually or by using two dissimilar welding dies. No cleaning process is

required when welding with manually induced relative motion.

A great deal of the work is developed to study the effect of the degree of metal prestraining ϵ on the bond strength. Up to ϵ = 0.75 the joint strength exceeds that of the base metal. However, the maximum joint strength can be attained with ϵ = 0.55.

Concerning the effect of the specimen geometry on the butt welded joint strength, the conical and hemispherical ends show lower threshold welding loads. On the other hand, the maximum bond strength can be attained at higher welding loads with the solid cylindrical flat end specimens.

The effect of the amount of oxides at the weld interface on the lap welded joint strength is investigated. It is shown that the breaking load decreases proportionally as the amount of oxide increases.

Chapter 1

INTRODUCTION

Pressure welding is one of the most ancient ever-known methods of metal joining. It simply consists of pressing two clean and coplanar surfaces together until they become close within interatomic distances in the solid state. This results in the existance of a metallic bond between the two facing surfaces forming a joint.

The earliest example of pressure welded work, may be the miniature head-rest found at Luxor in the innermost solid gold coffin of Tutankh-Amoun (1350 B.C.).

However, in the last few years, cold pressure welding has gained special significance due to the advantage that no heating is required, thus avoiding the serious defects such as cracks, pores, shrinkage...etc, which may be caused when using thermal welding methods such as fusion welding(1).

In addition, cold pressure welded joints can be attained between dissimilar metals as aluminium and copper which is generally met with practical difficulties when using fusion welding

Consequently, cold pressure welding has found many practical applications in industrial use. Welding of