Chapter 5

Tensile Behaviour

5.1 Introduction

The engineering tension test is widely used to provide basic design information on the strength of materials and as an acceptance test for the specification of materials. In the tension test, a specimen is subjected to a continually increasing uniaxial tensile force while simultaneous observations are made of the elongation of the specimen. An engineering stress-strain curve is constructed from the load-elongation measurements and the configuration of the stress-strain curve of a metal will depend on its composition, heat treatment, prior history of plastic deformation and the strain rate, temperature, and state of stress imposed during the testing. The parameters which are used to describe the stress-strain curve of a metal are: yield strength, tensile strength, percentage of elongation and reduction of cross sectional area. The first two parameters are strength parameters; the last two indicate ductility [65]. Hence, in this chapter, a complete analysis has been carried out to understand the influence of post weld heat treatment on tensile behaviour of friction stir welded AA7075 aluminium alloy.

5.2 Tensile Test Results

The transverse tensile properties such as yield strength, tensile strength, percentage of elongation and percentage of reduction in cross sectional area, notch tensile strength, notch strength ratio and joint efficiency of friction sir welded AA7075 aluminium alloy joints are presented in Table 5.1. In each condition, three specimens were tested and the average of three results is presented in Table 5.1. The details related to tensile test specimen preparation, dimensions and testing procedures are presented in Chapter III.

5.2.1 Yield strength

The stress at which plastic deformation or yielding is observed to begin depends on the sensitivity of the strain measurements. With most materials there is a gradual transition from elastic to plastic behaviour, and the point at which plastic deformation begins is hard to define with precision. The yield strength is the stress required to produce a small specified amount of plastic deformation. The usual definition of this property is the offset yield strength determined by the stress corresponding to the intersection of the stress-strain curve and a line parallel to the elastic part of the curve offset by a specified strain [66]. In this investigation, the yield strength is derived from the stress-strain curve at a specified strain of 0.2% and the values are presented in Table 5.1. Fig. 5.1 reveals the effect of post weld heat treatment on yield strength of FSW welded AA7075 aluminium alloy.

5.2.2 Tensile strength

The tensile strength is the value most often quoted from the results of a tension test. For ductile metals the tensile strength should be regarded as a measure of the maximum load which a metal can withstand under the very restrictive conditions of uniaxial loading. In this investigation, the tensile strength or ultimate tensile strength is obtained dividing the maximum load by original cross sectional area of the specimen and the values are given in Table 5.1. Fig. 5.2 shows the effect of post weld heat treatment on tensile strength of FSW welded AA7075 aluminium alloy.

5.2.3 Ductility

Ductility is a qualitative, subjective property of a material and the measurement of ductility is of interest to indicate to the designer, in a general way, the ability of the metal to flow plastically before fracture. The conventional measures of ductility that are obtained from the tension test are the engineering strain at fracture

Table 5.1 Transverse tensile properties of parent metal and FSW joints

Joint type	0.2 % offset Yield strength (MPa)	Tensile strength (MPa)	Elongation in 50 mm gauge length (%)	Notch tensile strength (MPa)	Notch strength ratio (NSR)	Joint efficiency (%)	Failure location
PM	510	563	16	571	1.01	-	
AW	335	394	12	410	1.04	70	AS-TMAZ
AA	251	314	14	449	1.43	56	AS-TMAZ
STA	346	445	11	512	1.22	79	AS-TMAZ

(PM: Parent metal; AW: As-welded; AA: Artificially aged; STA: Solution treated and aged)

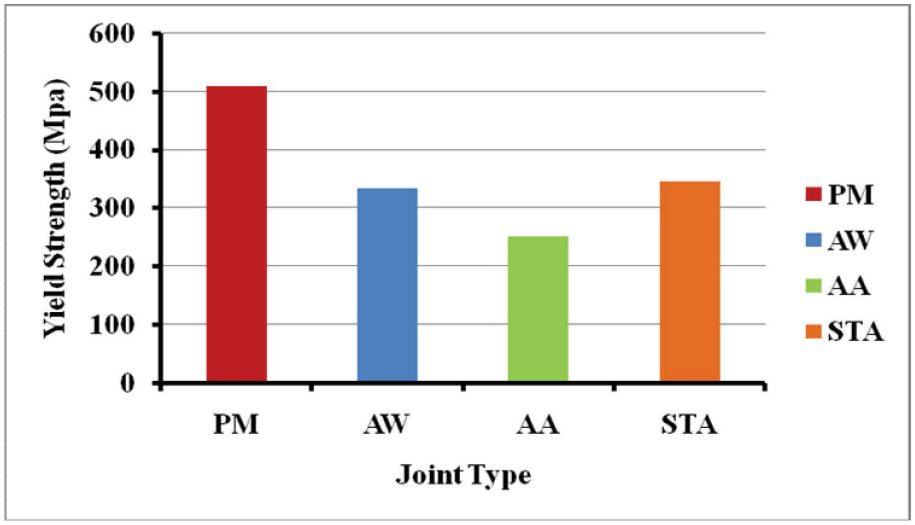
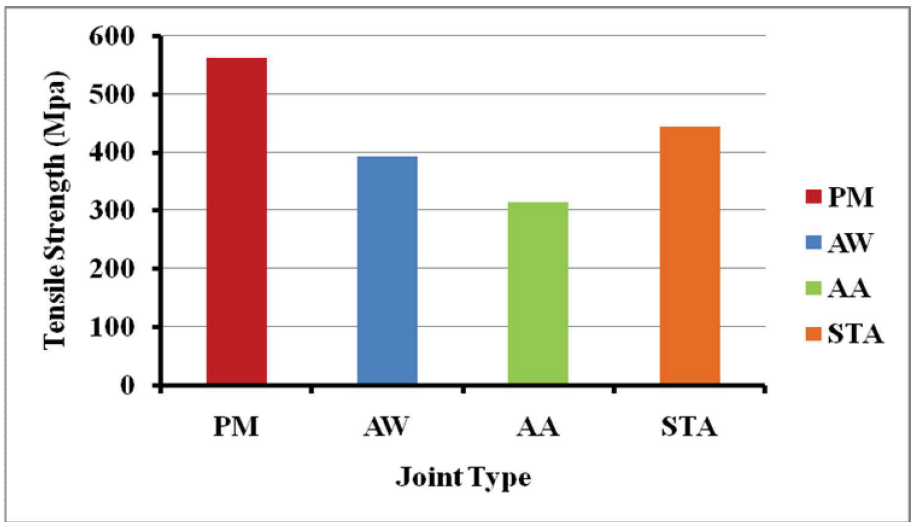


Fig. 5.1 Effect of post weld heat treatment on yield strength



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