Dissimilar Welding of Aluminium Alloy 6063 and Stainless Steel 316 by using Various Parameters and Evaluate the Mechanical Properties

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Abstract: **The object of the present work is to research the dissimilar material welding of SS 316 stainless steel and Aluminium alloy 6063 using stainless steel filler metals. Gas tungsten arc welding with identical parameters and procedures was used to carry out single V groove butt welding. The mechanical properties were performed. And to evaluate Toughness and hardness analysis to performed in the weld region. And evaluate the tensile strength of the material.**

1. INTRODUCTION

The requirements for the pharmaceutical and biotechnology industries are relatively high and the materials of construction for processing vessels and piping systems must demonstrate outstanding corrosion resistance and clean ability to ensure the purity and integrity of the drug product. Materials must be capable of withstanding the temperature, pressure, and corrosive nature of the production environments as well as all sanitizing and cleaning procedures. In addition, candidate materials must have good weldability and must be capable of meeting the industry's surface finish requirements.

The primary material of construction for processing equipment in the pharmaceutical and biotechnology industries is Type 316L austenitic stainless steel and Inconel steel. The corrosion resistance, weldability, electro polishing properties, and availability of the 316 grade and alloy steel P12 make it an ideal candidate for most pharmaceutical applications. Although Type 316 performs well in many process environments, users are continually looking to enhance the properties of When process environments are too aggressive for Type 316, users have either accepted the increased maintenance costs of a 316 system and aluminium alloy 6061 steel.

The project starts with chemical analysis of materials and preparation of WPS based on thermal and mechanical properties. Finally, the strength of material is calculated and compared with the ASME and AWS value. In welding by controlling the parameters of thermal property mechanical deviations are reduced and so weld with fewer defects could be obtained and also the service life of material will be increased.

2. MATERIAL SELECTION

Aluminium alloy 6063:

This monograph contains an outstanding introductory description of the properties of wrought and cast aluminium alloys and the enormous variety of their applications. From transportation and packing to construction, infrastructure and aerospace, the versatility of aluminium as a practical material is amply documented. The text is richly illustrated with numerous applications which demonstrate the enormous flexibility and the wide range of applications for aluminium alloys. This publication will be invaluable to engineers, designers and students unfamiliar with the variety of aluminium alloys and to those faced with an alloy selection decision. It outlines many of the issues to consider in selecting an alloy for a specific application and environment. Starting with a description of the aluminium alloy designation system, the text describes the major alloy series, outlines their primary chemical constituents, mechanical properties and major characteristics, and provides numerous examples of specific alloys in use. In summary, this monograph provides a lot of clarity to the process of selecting alloys for various applications.

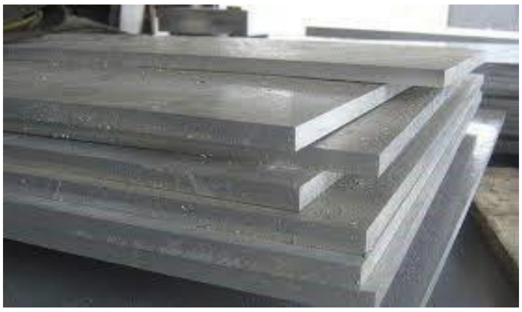

Fig 2.1 Aluminium 6063

Aluminium Properties:

Properties	Value
Elastic Modulus	69000 N/mm2
Poisson's Ratio	0.33
Thermal Expansions Co- efficient	2.4x10-5 /K
Thermal Conductivity	170 w/mk
Specific Heat	1300 J/kg k

Table 2.1 Properties

Stainless steel 316:

The most widely used wrought stain-less steels for cryogenic service are the AISI Types 304 and 304L, while Types 316, 316L, 321 and 347 are also used, dependent upon the availability in the particular form or size required. For temperatures below about -200°C the non-stabilized grades are generally preferred. Data for each of these types are included in the present publication together with summaries of the relevant European national specifications and steel designations. Data for the corresponding casting grades are also given. Particular care should be exercised in selecting appropriate grades of cast stainless steel for cryogenic.

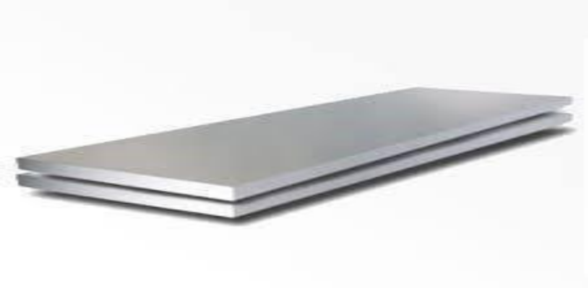

Fig 2.2 Stainless steel Alloy

ELEMENTS	% LEVEL
C	0.08
Mn	2.0
Si	0.75
P	0.045
S	0.03
Cr	16
Mo	2-3
Ni	10-14
N	0.10

Table 2.2 Composition

3. PROCESS

Welding Process:

Welding is a fabrication process that joins materials by causing coalescence in which heat is supplied either electrically or by mean of a gas torch,. This is often done by melting the work pieces and adding a filler material to form a pool of molten material (the weld pool) that cools to become a strong joint, with pressure sometimes used in conjunction with heat, or by itself, to produce the weld. This is in contrast with soldering and brazing, which involve melting a lower-melting-point material between the work pieces to form a bond between them, without melting the work pieces. Welding is also the least expensive process and widely used now a days in fabrication. Welding is also called as secondary manufacturing process.

Tig Welding:

Dc electrode negative (DCSP) is one in which the work piece is connected to positive and the electrode is connected to negative. In this type 70% of heat goes to work and 30% to electrode. In this type we can get deep and narrow penetration.

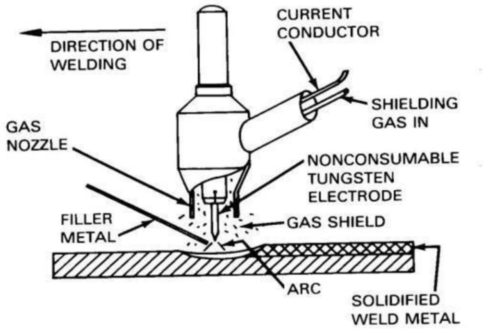

Fig 3.1

Dc electrode positive (DCNP) is one in which the work piece is connected to negative and the electrode is connected to work piece. In this type 35% of heat goes to work and 65% to electrode. In this type we can get wide and shallow penetration.

Alternating current (AC BALANCED) is one in which the 50% of heat goes to work and 50% to electrode. In this type we can get medium penetration. But the capacity of electrode is good when compared to DCE

Testing Process:

Tensile test:

Tensile test is used to determine the tensile strength of the specimen, % elongation of length and % reduction of area. Tensile test is usually carried out in universal testing machine.A universal testing machine is used to test tensile strength of materials. It is named after the fact that it can perform many standard tensile and compression tests on materials, components, and structures. The specimen is placed in the machine between the grips and an extensometer if required can automatically record the change in gauge length during the test. If an extensometer is not fitted, the machine itself can record the displacement between its cross heads on which the specimen is held. However, this method not only records the change in length of the specimen but also all other extending / elastic components of the testing machine and its drive systems including any slipping of the specimen in the grips.

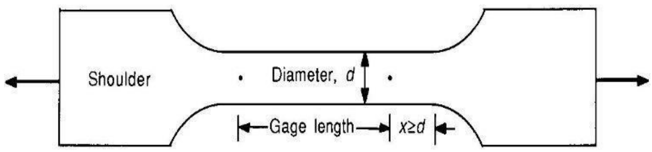

Fig 3.2

Hardness test:

A simple and economical way to characterize the mechanical properties and microstructure is by performing hardness measurements. By performing hardness measurements, the highest and lowest levels of hardness can be determined. In dissimilar metal welds the hardness level of parent metals and weld metal are determined. The most interesting part is where the transition from parent metal to weld metal takes place and in the root bead of the weld. A cross-section from each sample is taken transverse the weld by mechanical cutting. It is important that the preparations of the samples do not affect the surface metallurgical by hot or cold work. After the samples are cut they are grinded and polished in order to make as good preparation as possible.

Fig 3.3

Toughness test:

It is well understood that ductile and brittle are relative, and thus interchange between these two modes of fracture is achievable with ease. The term Ductile-to-Brittle transition (DBT) is used in relation to the temperature dependence of the measured impact energy absorption.

The principal measurement from the impact test is the energy absorbed in fracturing the specimen. Energy expended during fracture is sometimes known as notch toughness. The energy expended will be high for complete ductile fracture, while it is less for brittle fracture. However, it is important to note that measurement of energy expended is only a relative energy, and cannot be used directly as design consideration. Another common result from the Charpy test is by examining the fracture surface. It is useful in determining whether the fracture is fibrous (shear fracture), granular (cleavage fracture), or a mixture of both.

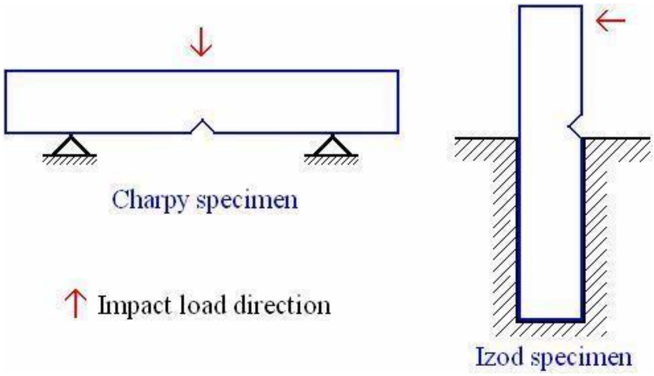

Fig 3.4

4.TEST RESULT

Tensile Test:

Thickness :6 mm

Width : 38mm

Area : 228mm^2

Yield Load	Yield Strength	Tensile Load	Tensile Strength
KN	N/mm^2	KN	N/mm^2
46.30	331.85	64.76	529.40

Table 4.1

Hardness Test:

Material	**Hardness Value in HRB**
Welded Alloy	134

Impact Test (Charpy):

Material	**Impact Value in Joules**
Welded Alloy	**77.5**

5.CONCLUSION

In raw materials before welding the Strength calculated and also Micro and chemical test is made to get the exact values of material composition. During Welding Strength will be decreased as because due to the change of properties and behaviour of materials. After Welding Heat treatment is to be carried out to maintain the strength of material. Finally, Tensile, Toughness and Hardness test are to be carried out.
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6.REFERENCES

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