The effect of heat input on hardness plate cold-rolled joint using cold arc joining technology

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ABSTRACT – Advanced technologies of gas metal arc welding (GMAW) to ensure quality of welding and to increase the rate of the productivities. Cold Arc one of technologies of GMAW based modifications of the short-circuit transfer mode for thin plate requirements. The main objective of this experiment is to study the influence of heat input to microstructure formation of material weld to indicated hardnes on impact cold-rolled plate joint with dissimilar thickness. The results of the test showed the joint by using low heat input exhibit higher hardness of the cold-rolled material. It is noted that higher input can lead lower hardness value and effects the coarse initial grain size.

1. INTRODUCTION

ColdArc is a new variation on low arc energy technology welding that introduces changes to improve the quality and the productivity of the welding performance[1],[2]. Robots welding is of the process of automatization to achieve high impact of production. Welding technology not to be misses several issues in cracking, distortion, and residual stresses have become a priority in the industry related to welding heat. The evolution of microstructure and grain size of weld joints that occur during heat applied [3],[4].

2. METHODOLOGY

The machine equipment is Cold Arc power source brand EWM. Solid welding wires grades ER70S-6 for mild steel with diameter 1.0 mm and gas mixture 82 % Argon + 18 % CO_2 are applying in the process. The two types of thickness joint are 1.0 mm and 0.8 mm with a lap joint. The experiments according to the data obtained from the literature review [5], and using the welding parameters given in [6].Process parameters present in Table 1.

Table 1 Welding Parameter

Level	Current (A)	Voltage (V)	Welding speed (mm/min)	Heat input (KJ/mm)
1	40	3.77	550	0.016
2	40	10.50	550	0.046
3	48	14.5	350	0.119

3. RESULTS AND DISCUSSION

A schematic of the weld geometry area in figure 1. Three-zone highlighted were base metal, HAZ and fusion. Two side measurement was on plate one and plate two in this experiment. Mechanical and metallurgical properties of the weld metal will be affected when increasing the energy input. It will also enhance the flux consumption, which increases pick up or loss of the alloying elements.

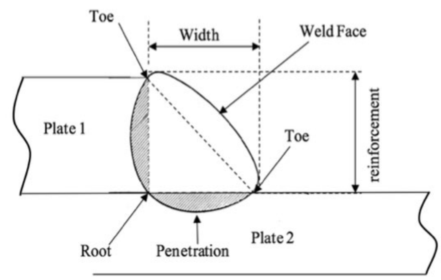


Figure 1 Weld bead geometry characteristics

An overview of Table 2 showed that the effect of hardness on parent metal. Figure 2 illustrated that unequal hardness results occurred. Increasing the heat input from 0.016 KJ/mm to 0.119 KJ/mm influenced the increasing hardness on sample test width from 179.3 HV to 239.1 HV.

Table 2 Microhardness result

Distance from the centre	Heat Input (KJ/mm)		
	0.016	0.046	0.119
	Hardness (HV)		
-5	130.1	132.1	125.8
-4	124.7	127.1	128.8
-3	145.7	150.9	170.6
-2	158.3	163.6	189.4
-1	179.3	209.1	239.1
1	135.2	139.6	174
2	127.4	128.1	144.3
3	130.3	133.2	133.6
4	118.7	113.6	122.2
5	112.8	115.3	129.4

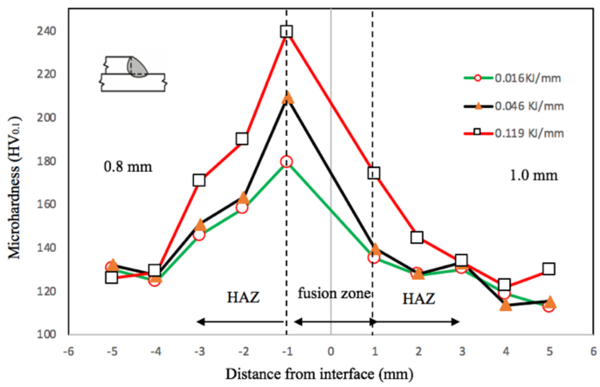
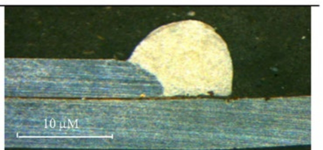


Figure 2 Graph hardness test distance from the fusion line

Table 3 Macrograph of the specimen test

Heat input (KJ/mm)	Macrostructure profile
0.016	
0.046	
0.119	

As shown in figure 2, the effects of microhardness related heat input along with a distance line. The results showed significantly heat input affecting the microhardness value on weld plate. Interestingly, there correlated with the results obtained by the previous researcher [4], [7] and [8]. The less hardness value was in the zone base material. The hardness increased if nearest to the fusion zone. The impact more effected at zone thin plate 0.8 mm compared to 1.0 mm thickness. The lightweight plate more impressed of heat input caused of high temperature the saturation thickness would be quite small, whereas for a low temperature it would be higher.

Table 3 shows the macrograph of specimen test this experiment. It is essential to determine the right welding speed and currently to minimize the microstructural evolution and distortions in the product.

4. CONCLUSION

The most significant findings from this study are that hardness results are related to heat input. After completing this work, several outcomes from the results shown above.

1) When heat input increases, the hardness specimen will increase.
2) The more significant hardness in the fusion zone and follow by HAZ.
3) The less affected zone is base material because far away from temperature distribution contributed to the microstructural evolution.

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