Analysis of the cutting shape in the underwater plasma cutting process for the horizontal position

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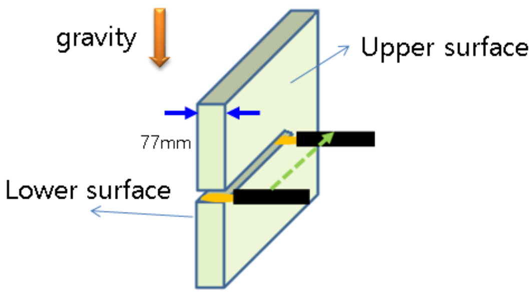
1. Introduction

The underwater cutting process is an essential technology for cutting reactor vessel internal (RVI). This is because RVI emits radioactivity above the medium level. The technologies used for underwater cutting include laser cutting, contact arc metal cutting (CAMC), bandsaw cutting, and plasma cutting [1-3]. Among them, the underwater plasma cutting process is a technology that must be performed because it cuts at high speed despite the large amount of second waste. In this study, the shape of the cutting part was analyzed according to the current, contact-tip working distance (CTWD), and cutting speed for underwater plasma cutting in a horizontal position.

2. Experiment conditions

In this study, a total of 27 experiments were performed with the level of the input variable as 3, and the experiment was planned through a full factorial design. SUS304 steel was used and the thickness of material is 77mm. Horizontal cutting was conducted as shown in Fig.1 for all cases



(a) Schematic of horizontal cutting

(b) Underwater plasma cutting

Fig.1. Schematic of underwater plasma cutting (a) horizontal cutting (b) Faculties in KEPCO KPS

Table 1: Experiment conditions of underwater plasma cutting

	Current (A)	CTWD(mm)	Cutting speed (mm/min)
Level 1	660	8	100
Level 2	680	11	150
Level 3	700	17	200

3. Results and discussion

In all experiments, piercing was not performed, but underwater plasma cutting was performed starting from the edge, and a length of 200 mm was cut on the upper surface. Fig.2 shows the examples of plasma cutting for upper and lower surface and it is found that the kerf of upper surface is bigger than that of lower surface. Moreover, it is possible to find out the dross on the lower surface

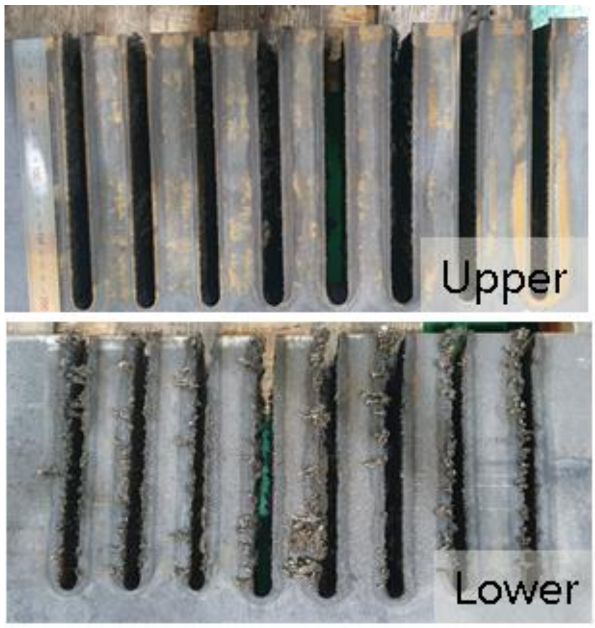
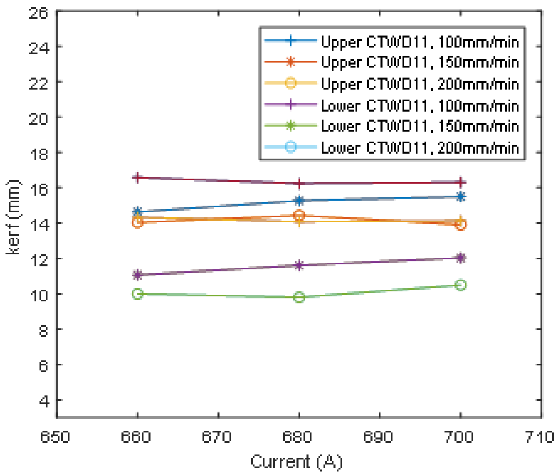


Fig.2.Examples of plasma cutting for upper and lower surface

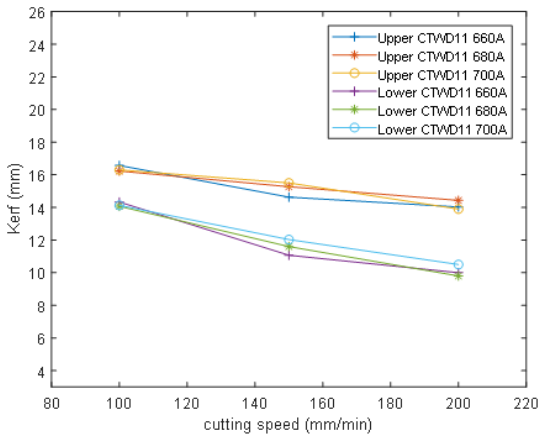
Fig.3 shows the kerf at the upper and lower surfaces according to the current, cutting speed, and CTWD, respectively. The change in kerf width due to the current is relatively small. The reason is considered to be that the level interval of the current used in this study was relatively small as 20A.

However, the change in the kerf width according to the cutting speed was confirmed to be relatively larger than current. When the cutting speed increases, it can be seen that the kerf width decreases in both the upper and lower surfaces, which means that the cutting performance decreases as the cutting speed increases.

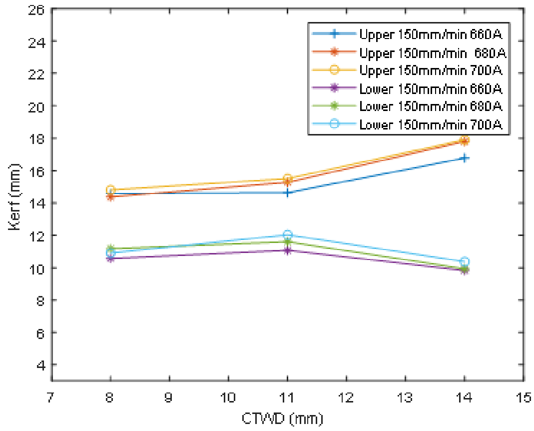
The CTWD variable also affects kerf width. When the CTWD is 8mm and 11mm, there is no significant change, but when the CTWD is 14mm, the upper kerf increases rapidly while the lower kerf decreases. In the case of CTWD of 14mm, the reason for the increase in kerf on the upper surface was that the arc plasma size increased with the increase of CTWD, so a relatively wider kerf width can be formed. In addition, when the arc plasma size increases on the upper surface, the density of arc force and the arc heat source decrease, leading to a decrease in the overall cutting performance. Therefore, the lower kerf at 14mm CTWD is smaller than 11mm CTWD.



(a) Current



(b) Cutting speed



(c) CTWD

Fig.3. Variations of upper and lower kerf for different input variables (a) current (b) cutting speed (c) CTWD

3. Conclusions

In this study, changes in kerf width according to current, cutting speed, and CTWD in underwater plasma cutting in a horizontal position were confirmed.

Acknowledgements

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