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The Impact of Different SMAW Electrodes on Trainee Skills Using Virtual Welding Machines at Baiji Oil Training Institute

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Abstract

This research aims to investigate virtual reality arc welding using shielded metal arc welding (SMAW) and to compare three different types of welding wire (E6010, E6013, and E7018) respectively. The working method includes testing for three types of welding. The method is SMAW, but there are differences in the welding wire (E6010, E6013, and E7018). The research results indicated a discrepancy in the welding results and a clear difference between the testers in terms of zigzag and filling of the welding field. Therefore, the highest score achieved of 51 of the E6013 wire types, which was reached at position 80, arc length 49, working angle 27, travel angle 42, and travel speed 60. The results will contribute to increasing the ability of the testers to obtain better future results through their knowledge of the errors that occurred.

Keywords**:** Virtual reality, Virtual welding, SMAW, E6013, E6013, E7018, OTIB.

دراسة مقارنة لثلاث انواع من آلات اللحام الافتراضي في معهد التدريب النفطي بيجي

الخلاصة

يهدف هذا البحث إلى دراسة لحام القوس بالواقع الافتراضي باستخدام لحام القوس المعدني المغطى ومقارنة ثلاثة أنواع مختلفة من أسلاك اللحام على التوالي. تتضمن طريقة العمل اختبار ثلاثة أنواع من اللحام. الطريقة هي سماو ولكن هناك اختلافات في سلك اللحام. أشارت نتائج البحث إلى وجود تباين في نتائج اللحام واختلاف واضح بين المختبرين من حيث التعرج وملء حقل اللحام. ولذلك فإن أعلى درجة تم تحقيقها وهي 51 من نوع السلك 6013 والتي تم الوصول إليها في الموضع 80 وطول القوس 49 وزاوية العمل 27 وزاوية السفر 42 وسرعة السير 60. وستساهم النتائج في زيادة قدرة المختبرين على الحصول على نتائج مستقبلية أفضل من خلال معرفتهم بالأخطاء التي حدثت.

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1. Introduction

Welding is the metallurgical process of uniting two metals into one by a heat process with no pressure. In industrial and metal welding, which is used to make structures, low-carbon steel is the base material, steel's nature is to fracture [1]. Welding is a fabrication method that combines materials, usually metals or thermoplastics, by melting the components together and then cooling them to induce fusion [2]. Welding, unlike lower-temperature procedures like brazing and soldering, does not melt the base metal (parent metal) [3]. Welding with austenitic stainless steel and low-carbon steel utilizing resistance spot welding resulted in a hardness of around 480 HV [4]. High-temperature welding has also been researched [5]. This study includes extrusion welding with a square butt joint of V-shaped steel-reinforced polyethylene (SRPE) corrugated tube, with the welding temperature kept between 190 °C and 200 °C [6]. The integration of laser welding technology into the GMAW process: Active weld beam geometry control [7]. In standard pulsed laser-enhanced gas metal arc welding (GMAW), a single fiber laser is focused and targeted at the droplet neck position to provide a laser recoil force, assuring droplet detachment irrespective of the article's welding current amperage [8].

The use of laser welding at low temperatures was researched by [9]. Keyhole mode Laser welding at lower ambient pressure is known to yield improved weld penetration, narrower breadth, and decreased defect incidences, however, the underlying process for these advantages is unknown [10]. Low transformation temperature welding (LTTW) consumables are distinguished by a low martensite initiation temperature and a high proportion of martensite development in the weld. The impact of coating on the welding process was investigated by [11], Press-hardening steels (PHSs) are used in modern passenger cars to increase part strength while reducing vehicle weight in order to meet both environmental and safety criteria. Some PHSs are zinc-coated to prevent oxidation and decarburization during heat treatment. High-temperature laser welding has also been researched [12]. In this work, samples of UNS S32304 DSS were subjected to two distinct laser welding conditions at varied temperatures (850°, 950°, 1050°, and 1150°C) for 10 minutes, and microhardness tests were conducted. Based on the findings, post-weld heat-treated samples at 1150 °C, the optimal temperature, were subjected to corrosion and tensile testing [13]. Gue et al. 2020 performed the first physical/microstructural simulation of seam weld formation during RW. A peak temperature of 1500 degrees Celsius and a 10-mm stroke produced a microstructure in the solid-state bond line, flash, and heat-affected zone that was identical to resistance-welded tubing built on an industrial scale [14].

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This study uses standard resistance spot welding (RSW) to link two types of *aluminum alloys*, AA5754-O and AA6022-T4, to interstitial-free *low carbon steel* (LCS). The larger AA6022 *weld nuggets* displayed enhanced mechanical performance when compared to the smaller 5754 nuggets [15]. Clarifying the impact of filler wire on the GTA in gas tungsten arc welding (GTAW) would help improve understanding of arc characteristics and stimulate new ideas for real-time monitoring of weld quality [16].

In the previous articles, several forms of welding are provided, and the virtual welding system that was utilized in this study is described as a very smart system with sufficient, working educational outputs that include the outcome of the student's test score [17]. In addition to detailed details about the quality of the welding, which includes the length of the welding wire and the intensity of adhesion between the two metals, and an illustrated picture of the welding shape, exhibiting the welding route line and its brightness [18]. The amount of slag created during welding. Furthermore, the system has the option to withhold the results from the two testers, ensuring competition between them. In general, the welding machine used in this research can perform four types of welding: tungsten inert gas (TIG), *flux-cored arc welding* (FCAW), *gas metal arc welding* (GMAW), and *shielded metal arc welding* (SMAW) [19].

However, this research focused on one type of welding, which is the type (SMAW), but the different types of welding wires that are; E6013, E6013, and E7018, the comparison between them, which indicates knowledge of the mistakes of welders and knowledge of methods of treatment and providing advice to them to increase experience and thus gain time and obtain a good welding.

2. Materials methods

2.1. Virtual reality welding machine

Figure (1) shows the virtual reality welding machine. In these experiments, a virtual welding machine was used Vertex 360 (SN U1190800852), in the laboratories of the mechanic department at Oil Training Institute Baiji (OTIB). In this study Four trainers, one trainee, three attempts.

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Fig. (1): The virtual welding machine

2.2. Virtual reality welding machine up

Figure (2) shows the virtual welding setup. The virtual welding machine consists of the main part, which is the welding machine, and a test table is equipped with an electronic screen that contains all welding conditions. The screen is connected to a computer that is used to store all the information that is obtained through the process connected with a printer to print the results [20].

Fig. (2): The virtual welding system setup

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3. Results and Discussions

3.1. SMAW welding method

Table (1) shows the data of SMAW welding. As shown in Figure (3), the results show the convergence of the results of E6010 and E6013, while there was a clear difference in the result of E7018, especially at the speed area [21]. This indicates that E7018 was welding faster than E6010 or E6013 [18]. The results in Figure 3 indicate that the result of welding type (E7018) was different, especially at point (Travel speed) where it achieved the highest result 83, which indicates the formation of slag in the weld or the speed of the welder [22].

Table (1): SMAW welding method included three wire types (E6010, E6013, and E7018)

Wire type	Welding type SMAW					
	Position	Arc length	Work angle	Travel angle	Travel speed	Score
E6010	94	71	84	49	60	42
E6013	80	49	27	42	60	51
E7018	80	34	15	0	83	42

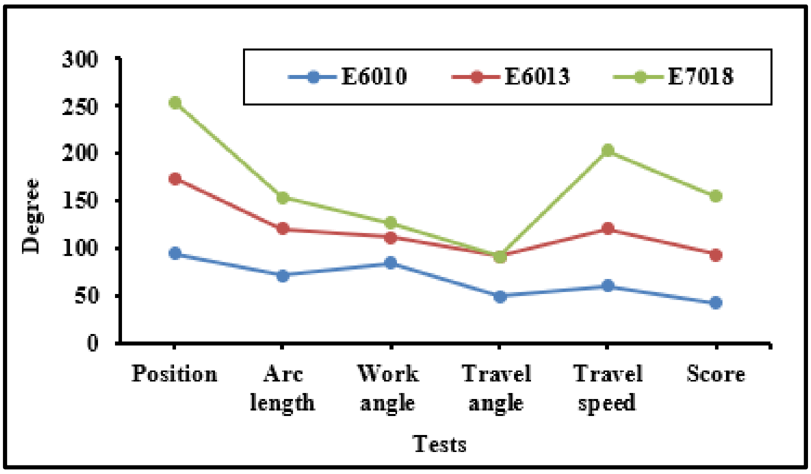

Fig. (3): Comparative among (E6010, E6013, and E7018) wire types

3.2. SMAW welding E6010 wire

Table (2) shows the data for the SMAW welding E6010 wire type. As shown in Figure (4) the results showed the appearance of a slight zigzag in the weld and straightness, perhaps the welder was experienced, had control and ability to weld [23]. However, there was a zigzag at the beginning of the weld or no control, then the weld settled in a straight line, which is better welding in this research [24].

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Table (2): SMAW welding E6010 wire type

Wire	Position	CTWD	Work angle	Travel angle	Travel speed	Score
E6010	94	71	84	49	60	42

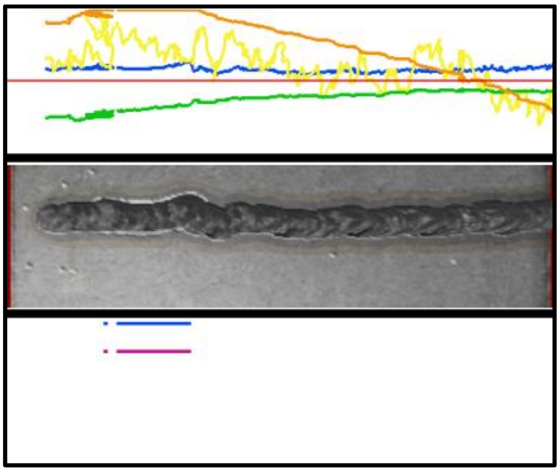

Fig. (4): SMAW welding E6010 wire type

3.3. SMAW welding E6013 wire

Table (3) shows the data of SMAW welding E6013 wire type. As shown in Figure (5) the results showed the appearance of a clear zigzag in the weld and a lack of straightness [25]. It is possible that the welder has no experience or did not have the control and ability to weld [26].

Table (3): SMAW welding E6013 wire type

Wire	Position	CTWD	Work angle	Travel angle	Travel speed	Score
E6013	80	49	27	42	60	51

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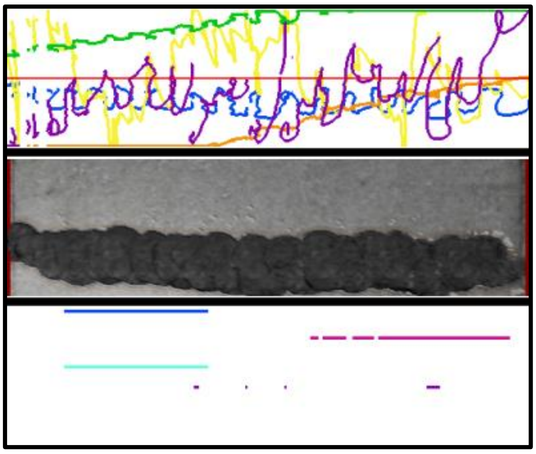

Fig. (5): SMAW welding E6013 wire type

3.4. SMAW welding E6018 wire

Table (4) shows the data for the SMAW welding E7018 wire type. As shown in Figure (6) the results showed the appearance of a slight zigzag in the weld and straightness, perhaps the welder was experienced and had control and ability to weld [22].

Table (4): SMAW welding E6018 wire type

Wire	Position	CTWD	Work angle	Travel angle	Travel speed	Score
E6018	80	34	15	0	83	42

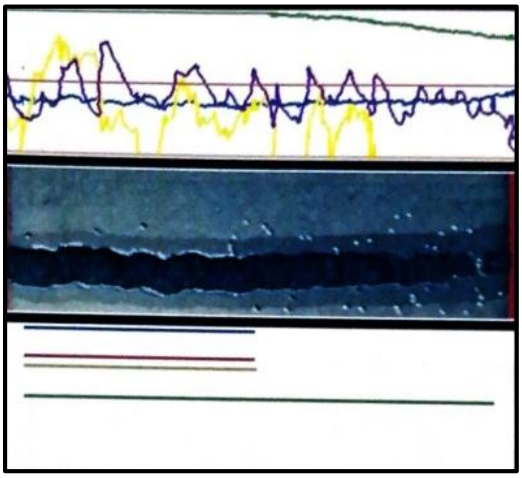

Fig. (6): SMAW welding E7018 wire type

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4. Conclusion

In this study, comparative study among three wire types (E610, E613, and E7018) SMAW welding was detailed. The results showed that the highest degree obtained by welding in the arc type (E6013) was (51), which indicates the effectiveness of this type of wire and its difference from other wires, or that the skill of the welder was better than the skills of welders. This research will contribute to encouraging students and applicants to take tests for this type of welding, while the main objective of this study is to study the comparison of the results of three students who used three different welding wires (E6013, E6013, and E7018) in the same method of welding (SMAW).

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