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THE STUDY OF MODERN WELDING EQUIPMENT AND THE METHOD OF IMPROVING THE QUALITY OF WELDING JOINTS

Abstract. This article analyses the modern welding equipment used in industrial enterprises, including methods of defect-free processing, as well as the methods of improving the quality of welded joints in the process of their use. Depending on the materials or characteristics of the products, different welding methods have been researched. MiG-MAG method of welding is reviewed. Defects arising during welding of metal surfaces were investigated. The basis of the research method is the use of modern welding equipment in production. Using KEMPPI, KOWELD welding equipment, a capacity of h3146,000 was prepared. The capacity used in the oil and gas industry is calculated on the mechanical strength, using new welding equipment, constructive improvement of the quality of welding classes of equipment used in oil and gas production is provided. The design of the h3146.000 capacity has been improved due to the use of welding activities. Improved design of the h3146.000 capacity base used in the oil and gas industry, calculate parameters for mechanical strength and welding using the Autodesk Inventor program.

Keywords. Welding, installation, carriage, lace, fit, seam, defect, strength.

Introduction.

Currently, welding equipment is an integral part of the preparation of the necessary equipment in the field of Mechanical Engineering and Metallurgy. The development of welding science and the scale of its practical use in production have led to rapid progress in the modernization of welding equipment every year, both constructively and internally. It is impossible to obtain high-quality welding without modern welding equipment [1].

Therefore, the continuous integration and modernization of welding equipment is a fundamental part of all production processes. Its results are currently becoming the most important factors in increasing the efficiency of industrial production. The solution to such a problem is impossible without the development of fundamentally new technologies and equipment that allow you to get a high-quality product at minimal cost. At the same time, in the current emerging conditions of market relations, the factor of high quality is different.

It should be considered as a real means of increasing the competitiveness of metal and non-metal products for the purpose and the main condition for the functioning of an industrial enterprise of any form of ownership.

Currently, in the machine-building and metallurgical industries, a high-quality product that gives the highest economic efficiency and has the highest technical, economic and operational indicators, that is, a product that fully meets the needs of the consumer, is realized by new technological processes and equipment.

Materials and Methods.

A number of production facilities in the country use foreign welding equipment. Among them is JSC Kentau transformer plant – a leader in the field of Electrical Engineering. In this regard, the development of defect-free processing methods using competitive modern welding equipment is relevant.

Depending on the materials or features of the products, different welding methods are selected, for example, manual arc welding with instance electrodes with MMA coating, or manual argon welding with tungsten non - melting electrodes with Tig - protective gas (argon). However, MiG-MAG welding is the most common. MiG-MAG welding: MIG is welding in which an inert gas such as helium or argon acts as an insulating medium, MAG is a type of lathe using an active gas such as nitrogen, carbon dioxide, etc. [1-2].

The advantages of the MIG-MAG method in comparison with other types of welding are the highest degree of protection of molten metal due to the use of protected gases. They do not allow air to enter the working area, while well insulating the welding bath from external influences, ease of use. MIG-MAG allows you to work in any conditions and allows you to visually monitor the welding process, form a seam and, if necessary, correct it. The seam is obtained more smooth and with a complete absence of slag. This allows you to save time on cleaning the treated metal surface, and the performance of this method is the highest.

MIG / MAG welding is a kind of Arc Welding in a protective gas environment. The arc lights up between the non-stop supplier and consumable Solder wire and the work surface. The arc and welding bath are protected by active and inert gas. The process can be used with many materials and a wide range of soldering wires.

Compared to manual arc welding, MIG/MAG welding is more productive. There is no need to change the electrodes too often. The use factor of welding materials is high, because no waste is thrown away. As a rule, about 65% of each kilogram of electrodes used falls on the metal rod welding seam. In the case of a soldering Wire, its value reaches about 85-90%.

MIG/MAG welding is a versatile process that delivers high melt rates in all conditions. This capability is used throughout, including carbon, low-alloy and high-alloy materials based on nickel and aluminum. MIG/MAG pulse welding is used for welding multi-alloy steel and aluminum. Welding wire is widely used because it has many properties in addition to high productivity.

Nowadays, new devices such as KEMPPI, KOWELD, FastMig X, SuperSnake and GT02S/GT02SW are widely used to improve welding productivity. The KEMPPI device used in the welding activities of JSC "KTZ" is shown in Figure 1.

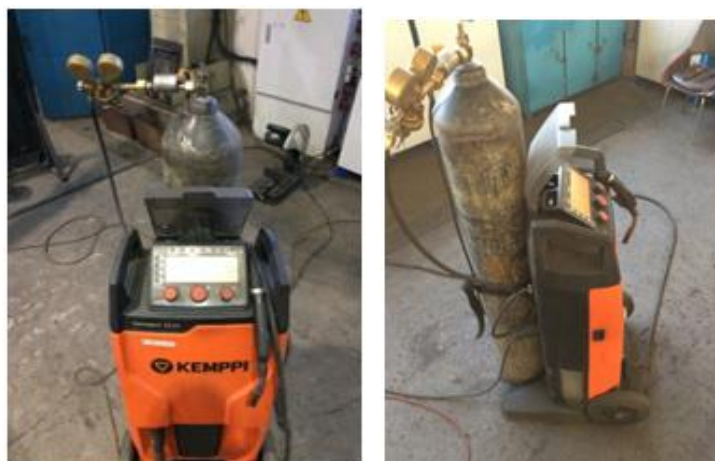


Figure 1 - Modern semi-automatic welder KEMPPI

During manual and automatic welding, in addition to welding under the flux layer, gas protection of the welding bath from contact with the environment is used to protect the metal from air oxygen and nitrogen.

Argon arc welding and carbon dioxide welding are widely used in industry. Welding with these methods can be performed with fusible and non-fusible electrodes using alternating and direct current. Welding work in shielding gases is shown in Figure 2.



Figure 2 - Welding work in shielding gases

The parameters of the technological mode of welding in the carbon dioxide medium are selected depending on the thickness of the product and the brand of steel to be fired, taking into account the location of the part in space. Soldering is usually done in reverse polarity.

It is better to weld the baking joints of thin products with copper linings, and cross joints without lining. In these and other cases, the quality of the assembly of the product to be welded is of great importance. It is recommended to weld products made of thick metal with an electrode wire with a diameter of 1.6 and 2 mm.

At the same time, a satisfactory formation of the seam with a depth of pre-baking up to 6...7 mm is achieved, which allows two-sided cross welding without beveled edges in products with a thickness of up to 10...12 mm.

For welding thicker products, it is recommended to split the edges, as shown in Figure 3.



Figure 3 – Welding the surface of a plate made of steel 09G2S with a thickness of 16 mm using the chamfer cutting method

For an illustrative example, a joint was made on one plate with a simple electrode and also with a semi-automatic welding machine with KEMRRI wire feed. We can see the difference, it's easy to tell which machine the part was made with.

The part on the left is made with a simple electrode, the width of the part is uneven, etc., and there is a lot of sputtering, and the part on the right is made with a semi-automatic welding

machine, the part is uniform, the metal splatter is small, and the metal does not need to be cleaned very hard after welding, in conclusion, it is produced reduces the labor capacity of the product. This analysis is shown in Figure 4.



Figure 4 - Visual types of classification of old and modern welding machines

During the formation of a welded joint on metal, defects can be formed in the area of the edge and thermal effect, which destroy the durability, serviceability, accuracy and appearance of the product [3-4].

In the process of working in production, we can see the type of defects that appear in the welding of metal surfaces in Figure 5.

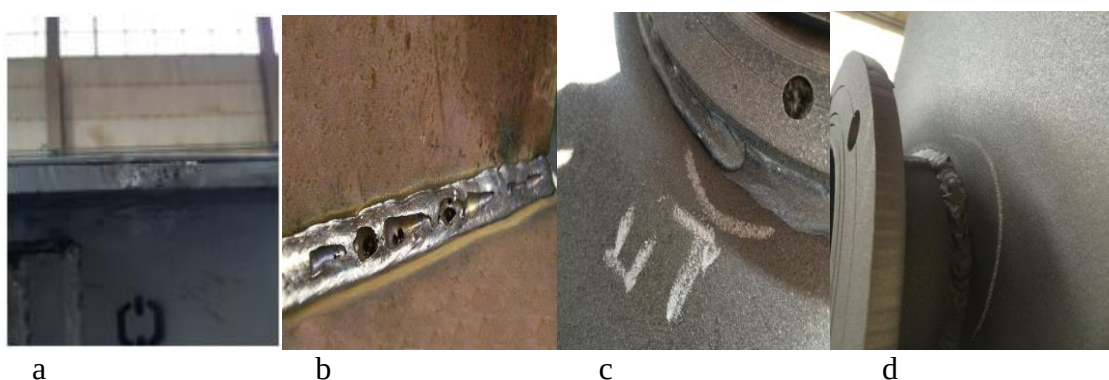


Figure 5 - Visual display of defects:

- a) upper holes, b) castings of welding joints, c) craters of welding joints,
d) caps of welding joints

Defects can greatly affect the strength of the welded joint and cause premature failure of the welded structure. Especially during cyclic loads, defects in the form of light (cracks, under-welding) that sharply reduce strength are very dangerous [5-6].

Results and Discussion.

Mechanization of welding activities is carried out as follows. Aligns two metal plates, leaving a gap between them for welding the metal edge.

Next, with the help of special fixing magnets, the base of the carriage (it is a self-propelled track of the carriage) is installed. Places the welding lace and fixes it in the form of a yoke in a specially allocated place, and then adjusts it so that the welding wire comes out of the junction of the two plates during welding [7-8].

Further, KEMPPI adjusts the voltage, feed rate and other characteristics of the welding machine. In the welding carriage, the welder sets the parameters of the carriage, that is, the direction of movement, the speed of movement of the carriage along the base, etc. regulates.

In this way, the welding of capacity walls is carried out, and the following factors are reduced: human factor, labor capacity of the manufactured product, defects. Figure 6 shows the type of modern welding equipment used in the oil and gas industry.

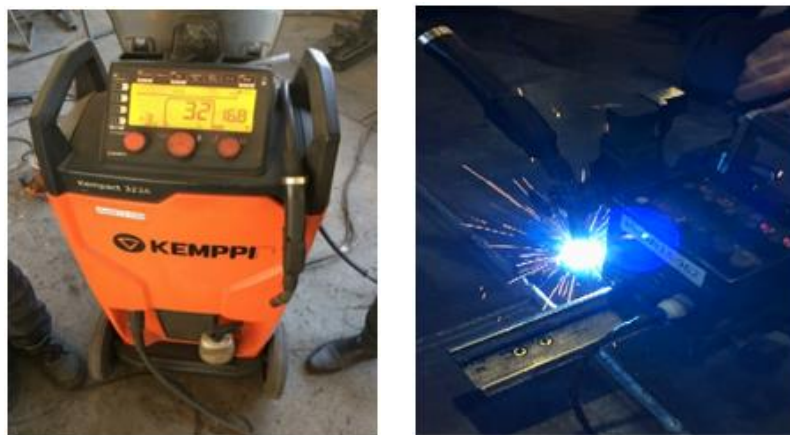


Figure 6 - The process of using KEMPPI and KOWELD welding equipment

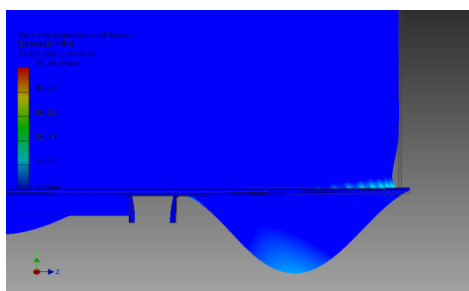
Using KEMPPI, KOWELD welding equipment, during production of H3146,000 capacity, JSC "KTZ" uses St3sp steel grade according to MEMST 27772-88, as it is the best grade of steel to be welded. In order to improve labor productivity during capacity wall welding, the KEMPPI welding machine is used together with the KOWELD automated welding carriage [9-10].

First, welding is performed at the adjacent wall joint. We get the capacity wall. In general, the type of capacity of the main welding work piece is as follows: Figure 7.

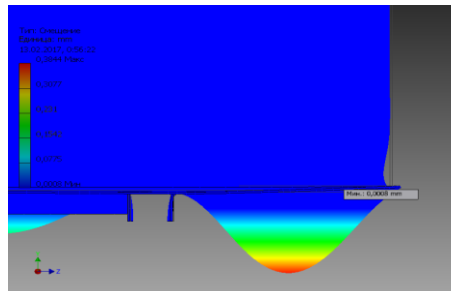


Figure 7 - Capacitance type after welding work

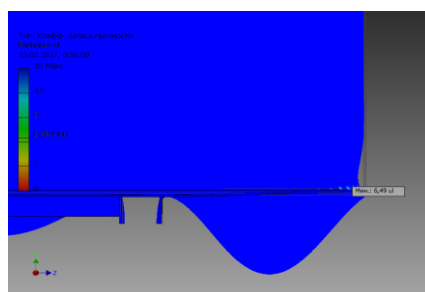
Calculations of capacity to mechanical strength and welding seam parameters were performed in Autodesk Inventor program. One of the initial data is the weight of the liquid 2900 kg and the main load is the pressure at the bottom of the container.



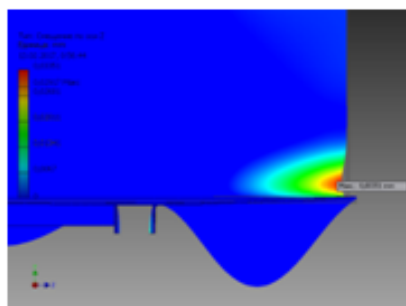
Mises stress



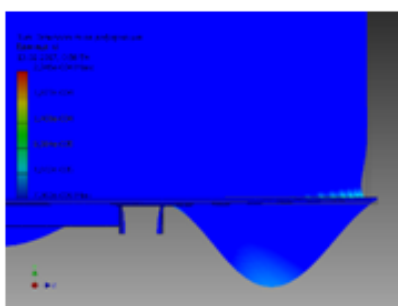
Shear



Strength reserve factor



Z axis displacement



Equivalent strain

Figure 8 - Distribution view of calculation of capacity for mechanical strength and weld seam parameters, first version

The report was issued in two versions. Based on the obtained numerical simulation results, in the first version, there is no necessary base at the bottom of the container, therefore, the result of the calculation shows a deflection due to the pressure caused by the oil. In the version of the second calculation, the strength properties were increased by adding an additional foundation to the base of the capacity Figure 8-9.

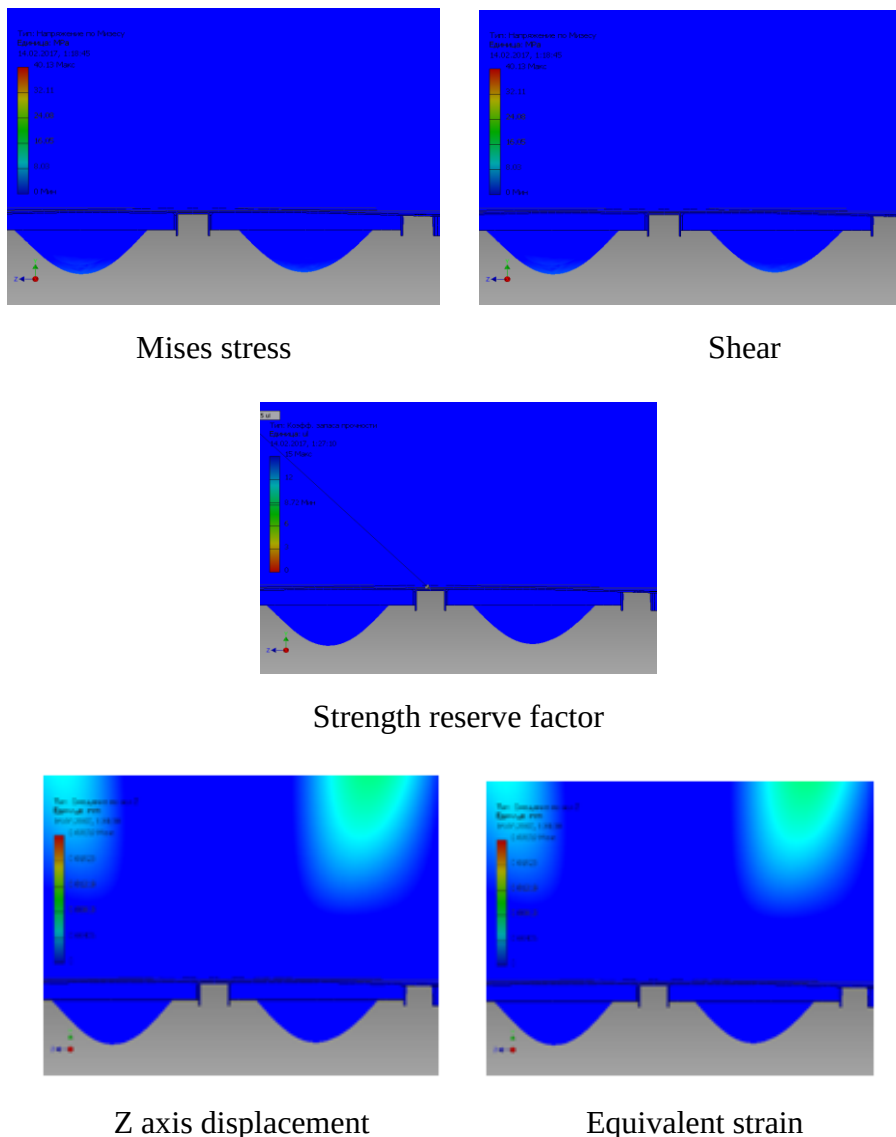


Figure 9 - Distribution view of calculation of capacity for mechanical strength and weld seam parameters, second version

In the second version of the capacitance calculation, you can see how the voltage changed after adding additional grounding.

Conclusion

Experiments and theoretical studies revealed during the monitoring show that the quality of the manufactured product, including the quality of welding activities, increases in the process of using modern welding equipment. In particular, the types of defects that are most noticeable in welded joints are significantly reduced.

H3146.000 capacity produced at the Kentau transformer plant is produced with modern welding equipment of ESAB, KEMPPI and KOVELD. Calculation of this capacity to mechanical strength and welding seam parameters was carried out in Autodesk Inventor program. Differences between old and modern welding equipment were revealed during welding work in practice.

REFERENCES

- [1] Threadgill P.L., Leonard A.J., Shercliff H.R., Withers P.J. Friction stir welding of aluminium alloys. International Materials Reviews. 2009, Vol. 54, Issue 2, ISSN 0950-6608, DOI: 10.1179/174328009X411136, pp. 49–93.
- [2] Mathers G. The Welding of Aluminium and its Alloys. Cambridge: Pub. Woodhead Publishing, Ltd, 2002, 242 p
- [3] Threadgill P.L., Leonard A.J., Shercliff H.R., Withers P.J. Friction stir welding of aluminium alloys. International Materials Reviews. 2009, Vol. 54, Issue 2, ISSN 0950-6608, DOI: 10.1179/174328009X411136, pp. 49–93.
- [4] Thomas W.M., Norris I.M., Staines D.G., Watts E.R. Friction stir welding – process developments and variant techniques. SME Summit. Oconomowoc, 3-4 August 2005, Milwaukee, USA. pp. 1–21. Available at: http://hegesztesportal.hu/tudastar/wt_fsw.pdf
- [5] Yakhin A.V., Udalova E.A., Karetnikov D.V., Tokarev A.S. The role of Russian scientists in the development of the first technologies for welding metals // History of science and technology. - 2019.- No 11.- P.57 - 62.
- [6] Mulikov D.Sh., Yakhin A.V., Karetnikov D.V., Abakacheva E.M., Tokarev A.S. Problems and ways to improve the technological process of obtaining combined pipe connections with tube sheets of shell-and-tube heat exchangers//Oil and Gas Business. - 2017.- Vol. 15, No 2. - P.134-140.
- [7] Domnina E.G. Method for improving the quality of welded joints/E. G. Domnina. - Text: direct/Young scientist. - 2011. - No 5 (28). - Vol. 1. - P. 46-48. - URL: <https://moluch.ru/archive/28/3085/> (access date: 30.05.2024).
- [8] Malkina I.V., Zhdanov D.V. Improving the quality of control of welded joints in the production of mechanical engineering products. News of the Samara Scientific Center of the Russian Academy of Sciences, vol. 23, No. 3, 2021 p 40-45.
- [9] Dubinkin D.M., Bakulin E.V. Weld mechanical properties test procedure: method. instructions for the course work on the course "Desing and Production of Blanks" for students of the direction 552,900 specialties 120100, 120200, 120500/comp.: D. M. Dubinkin, E. V. Bakulin; GU KuzGTU. - Kemerovo, 2004. - 21 p.
- [10] Gorshkova O.O. New technologies in welding production. Modern high-tech technologies. – 2021. - No. 2 - P. 14-18.

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ЗАМАНАУИ ДӘНЕКЕРЛЕУ ЖАБДЫҚТАРЫН ЗЕРТТЕУ ЖӘНЕ ДӘНЕКЕРЛЕУ ҚОСЫЛЫСТАРЫНЫҢ САПАСЫН АРТТЫРУ ӘДІСІ

Аңдатпа. Бұл мақалада өндірістік кәсіпорындарда қолданатын заманауи дәнекерлеу жабдығына талдау жүргізілді, заманауи дәнекерлеу жабдығын пайдалана

отырып ақаусыз өңдеу әдістері, сондай-ақ оларды пайдалану процесіндегі дәнекерлеу қосылыстарының сапасын арттыру әдісі қаралды. Материалдарға немесе бұйымдардың ерекшеліктеріне байланысты дәнекерлеудің әртүрлі әдістері зерттелді. Дәнекерлеудің MIG-MAG әдісі қарастырылды. Металл беттерді дәнекерлеу кезінде туындайтын ақаулар зерттелді. Зерттеу әдісінің негізінде өндірісте заманауи дәнекерлеу жабдығын қолдану саласы жатыр. KEMPRI, KOWELD дәнекерлеу жабдықтарын қолдана отырып, НЗ146.000 сыйымдылығы дайындалды. Мұнай-газ саласында қолданылатын сыймдылық механикалық беріктікке есептелген, жаңа дәнекерлеу жабдығын қолдана отырып, мұнай-газ өндірісінде қолданылатын жабдықтың дәнекерлеу жіктерінің сапасын конструктивті жетілдіру көзделген. НЗ146.000 сыйымдылық конструкциясы дәнекерлеу жұмыстарын пайдалану есебінен жақсартылды. Мұнай-газ саласында қолданатын НЗ146.000 сыймдылық негізінің конструкциясын жетілдіріп, механикалық беріктікке және дәнекерлеу жігінің параметрлерін есептеу Autodesk Inventor бағдарламасы көмегімен екі нұсқада орындап теориялық тұрғыдан дәлелдеп, өндірістік кәсіпорында қолданысын тапты.

Түйінді сөздер. Дәнекерлеу, қондырғы, күймеше, шілтер, сыймдылық, жік, ақау, беріктік.

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МЕТОДЫ ИССЛЕДОВАНИЯ СОВРЕМЕННОГО СВАРОЧНОГО ОБОРУДОВАНИЯ И СПОСОБЫ ПОВЫШЕНИЯ КАЧЕСТВА СВАРОЧНЫХ СОЕДИНЕНИЙ

Аннотация. В данной статье проведен анализ современного сварочного оборудования, применяемого на производственных предприятиях, рассмотрены методы обработки с использованием современного сварочного оборудования, а также методы повышения качества сварочных соединений в процессе их эксплуатации. Были изучены различные методы сварки в зависимости от материалов или особенностей продукции. Рассмотрен метод сварки MIG-MAG. Исследованы дефекты, возникающие при сварке металлических поверхностей. В основе метода исследования лежит область применения современного сварочного оборудования в производстве. С помощью сварочного оборудования KEMPRI, KOWELD была подготовлена емкость НЗ146.000. Предусмотрено конструктивное совершенствование качества сварных швов оборудования, применяемого в нефтегазовой отрасли с применением современного сварочного оборудования, рассчитанного на механическую прочность. Емкостная конструкция НЗ146.000 улучшена за счет использования сварочных работ. Усовершенствована конструкция основания емкостей НЗ146.000, применяемая в нефтегазовой отрасли, используемая на

производственном предприятии, выполнен расчет параметров механической прочности и сварного шва в двух вариантах с помощью программы Autodesk Inventor.

Ключевые слова. Сварка, оборудование, каретка, проволока, емкость, шов, дефект, прочность.

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