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PREPARING PROCESS OF STEEL SURFACES OF SHIP'S BALLAST TANKS - APPLYING THE RESOLUTION MSC 215 (82)

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SUMMARY
Applying the resolution MSC 215 (82) in the ship hull production (area of ballast tanks) brought an implementation of new processes and procedures in preparation of steel surfaces before painting a section, ballast space, and also in delivery of them to the representatives of the classification societies, ship inspectors and authorized inspectors of colour. In ship's hull production, surface preparation is a demanding technological work operation which begins with primary surface preparation (preparation of plates and sections for dyeing workshop with protective coating) and continues with the preparation of steel before painting of sub-assembled sections and blocks according to ISO 8501-3 grade P2 . The surface preparation or additional surface preparation work, according to the above mentioned standards, require some additional technological time, a new human resources which in the end can significantly affect the ship's hull building time and the final price of the vessel in its entirety. Shipyard has to apply [1]control process over surface preparation during the process of drafting and construction of hull and provide in this way the impact on production costs, reduce them to a minimum at each stage of the production process, respecting the norms and criteria for processing, quality control and hull building schedule.

Key words: steel surfaces preparation, procedures, control of processes, costs

1. INTRODUCTION

Today' s global competition and economic crisis in the world to which the ship building process is exposed, require that each shipyard aims to make the final product, the ship that will be recognizable in the market with the use of international standards and quality with cost control process to ultimately achieve profitability of the shipyards. This paper present the application of standard 8501-3 grade P2 to the application of surface preparation of steel sections in ballast 46000 dwt chemical tankers, analyzing the costs of production and use of other technological processes to reduce them.

[1] *The results presented in the paper have been derived from the scientific research project „New Technologies in Diagnosis and Control of Marine Propulsion Systems" supported by the Ministry of Science, Education and Sports of the Republic of Croatia.*

2. IMPLEMENTATION OF MSC IMO 215-82 RESOLUTION IN BALLAST TANKS

Implementation of standards for the protection of the coating (standard performance of protective coating) provides technical requirements for the protection of coatings in ballast tanks [1], MSC 215-82 (coat in good condition in a period of 15 years in the ballast tanks). This resolution was adopted by the IMO (International Maritime Organization), Maritime Safety Committee, MSC 82 in 8. December 2006., Istanbul. According to the SOLAS Convention (Safety of Life at Sea) requirements and data are:

- for ships of not less than 500 gross tonnage,
- for those in the construction contract on or after 1 Jan 2008,
- in the absence of the building contract, the keel, which are laid or which is at a similar stage of construction on or after 2012 years.

For ships covered by IACS rules and standard structures CSR (Common Structural Rules), PSPC applies:

- ballast tanks of double hull tankers with L≥150 m,
- ballast tanks of bulk carriers with L≥90 m,
- double side space for bulk cargo L≥150 m.

3. THE TECHNOLOGICAL PROCESS OF VOLUME SECTIONS

Inputs to the workshop process in the sub-assembly shop are: technical and technological information (workshop documentation) that the output of the design process, design and technology of the vessel, surfaced elements of the hull of the vessel, which are output from the previous processing of steel in the workshop process, or made in the market purchased additional equipment and supplies needed for welding. The flow of material flowing through the sub-assembly shop from making sub-assemblies in the area where a small sub-assembly shops are usually made of two or more individual elements within that strip and sections are assembled and welded to the plates, taking into account the quality (it's finishing and repair small sub-assembly shops) and the dimensional accuracy of the assembly. At the same time making the panel follow the line that consists of five cycles.

4. TECHNOLOGICAL PROCESS OF SURFACE PREPARATION

Surface preparation is a complex technological operations working in the development of hull from primary surface preparation of plates, profiles and flats performed in the automatic installation (clean steel surface under the contract defined surface condition [2] Sa 2.5 according to ISO 8501-1, 1988) and applying the basic workshop called coating" shop primer" in the film thickness 15-20 µm to be the protection of steel in the process of ship construction. Mandatory to control the thickness of the film coatings for greater thickness adversely affects the cutting speed and quality of steel and the occurrence of errors in welding. Secondary surface preparation is carried out in the halls for sandblasting and painting [5] where the surface of the sections should be removed from dirt, salt and was degreased and sandblasted section according to standard ISO 8501 – 1 (to remove any defects arising in the course of the volume section). Before performing a secondary surface preparation is done preparing the steel surface (ballast space) called steel preparation according to ISO 8501 – 3 grade P2, which includes repair and finishing of steel in volume section. This technological operation is extra work in welding and grinding works and represents large share of the cost in total production volume for standard section of the sub-assembly shops. Table 1. shows working operations of central section of double bottom in the ballast area of the ship and their share in the overall standards of producing these section and the share of hours to prepare the steel surface according to ISO standard 8501 – 3, grade 2, 2001.

Table 1. Norm of working operations for the preparation of the volume section 3112 – 89 ton (central section of double bottom) ballast tank 46 000dwt chemical tankers.

OPERATION	VALUE WORKSHEET [working hours]	SHARE OF TOTAL HOURS REGULATIONS [%]
Assembly of subassemblies	90	4.9
Welding sub-assemblies	125	6.8
Welding and gridding works the processing of steel in the small sub-ass.	40	2.2
Panel lines I, II and III	130	7.2
The assembling spatial section	450	24.6
Welding spatial sections	700	38.4
Welding and gridding works processing of steel section	(150+140)	15.9
TOTAL	1825	

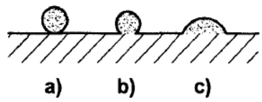
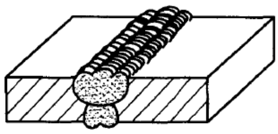
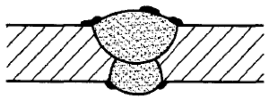
The technological process of preparing the steel surface according to ISO standard 8501 – 3, grade P2 for the construction of hull should define the phases of the structure:

- Ordering bespoke steel sheets according to the ISO 8501 – 3 grade P2 (treatment free edges with radius r = 2 mm),
- Cutting steel flats (automated plasma cutting),
- Finishing and repair of structures (repair welds, cut edges and damaged areas) in the stage of making circuits on a small area of sub-assembly shops,
- Processing of structure in the phase of teaching a section or area of insurance company inspectors and inspectors from the representatives of ship owners,
- Possible correction (repair weld and grinding) after the secondary surface preparation prior to coating application.

4.1. Description of criteria for surface preparation of steel according to ISO standard 8501-3 grade P2

Criteria for surface preparation of steel are divided into several stages (P1, P2 and P3) as a function of each shipping destination. Grade P3 is the most difficult to apply [4] to cargo tanks for chemicals and drinking water tanks, level P2 in ballast spaces, exterior panels and the main deck and the level of P1 in the engine room, dry room and superstructure inside. Most often way of debugging stage P2 the repair weld-surfacing, grinding free ends by the criterion radius r = 2 and the elimination of surface damage. Table 2. shows the errors and their correction depending on the degree of processing in accordance with ISO 8501-3.

Table 2. Detail ISO standard 8501 - 3.2001.

Type of imperfection		Preparation grades		
Description	**Illustration**	**P1**	**P2**	**P3**
1 Welds				
1.1 Welding spatter		Surface as obtained	Surface shall be free of all loose welding spatter [see a)]	Surface shall be free of all welding spatter other than that without under-cutting [see c)]
1.2 Weld ripple/profile		As welded	Surface shall be dressed to remove irregular- and sharp-edged profiles	Surface shall be fully dressed, i.e. smooth
1.3 Welding slag		Surface shall be free from welding slag	Surface shall be free from welding slag	Surface shall be free from welding slag
1.4 Undercut		Surface as obtained	Surface shall be free from sharp undercuts	Surface shall be free from deep or jagged undercuts

4.2. The costs of welding and the influence of inert gas to the losses splash of metallic drops

In general we can say that the proportion of inert gas in the welded structure can be a relatively important determinant of the cost. A cost of inert gas need not be and often is not the crucial factor that determines the price of contracts (share of gas in a welded construction with MAG welding (see figures 1. and 2.) can be in the order of 2 – 5 %, but is much more significant impact on the use of inert gas welding speed and reduced costs of subsequent processing (grinding, cleaning the rest of the guns, etc. ..), then the total cost of the welding process . In direct dependency with these costs are the costs subsequent treatment/cleaning (removing traces of spray nozzle with inert gas, work piece and tool). In MAG welding in a atmosphere of 100% CO_2 shielding gas (increased CO_2 content to work in forced positions for welding thicker sheets), particularly in the high current leads to a significant splash (see figures 3. and 4.) and consequently to increased costs.

When spraying occurs uncontrolled flight droplets of molten metal, which means that they are due to a heat content can collected of basic materials and the welding gun nozzle.

As this is an uncontrolled spray or continuous spraying with progressive sticking inside the nozzle which reduces the cross-section of the nozzle, and then come up turbulent flow inert gas that does not ensure proper protection of the melt and the filler material from the atmosphere, which ultimately gives the error in the weld. To prevent these problems from the cleaning nozzle [3] collected droplets and removing these droplets in to the weld can use the tool against the stickers. Funds are coated base material and the nozzle does not reduce significantly the splash, but for easy cleaning. A very important influence on the type of spraying is inert gas, using gas mixture of argon and active components (Krystal 18 with 18% CO_2, Krystal 8 with 8% CO_2, Argomix 8 with 8% O_2).

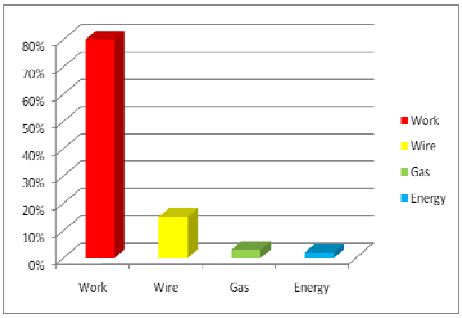


Figure 1. The average cost structure in MAG welding of carbon steel

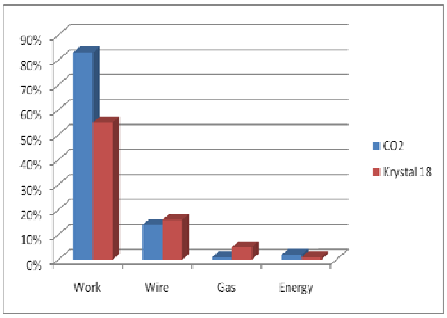


Figure 2. Preview of the cost MAG welding with 100% CO_2 or a mixture of 18% CO_2 in argon

In practice, these mixtures showed a very usable as a thin, is so thick plates, the weld of superior quality, non-marking guns, and with good penetration in thicker plates, with very good mechanical properties, smaller granularity and increased impact toughness of welded joint and increased welding speed. All of the above reduces the cost of subsequent processing of steel, a smaller number of workers (welders and grinder), accelerates the production process of drafting section and increases the quality of welding. Figure 2. shows the ratio of costs MAG welding [6] with 100% CO_2 and a mixture of 18% CO_2 in argon which shows that the other proceedings have lower costs of subsequent treatment of steel with a higher initial price of gas.

Figure 3. The inner space of the central section double bottom ballast spaces

Figure 4. Weld between plates

5. CONCLUSION

In the demanding world shipbuilding market can exist only those shipyards, where the final product meets the criteria of quality, price and delivery time. To fulfil these conditions they must apply new technology, make quality improvement methodology, depending on cost of the process. Welding is one of the most common technological processes in the shipbuilding industry, and because of greater demands for increased productivity and quality should strive to automate this technological process which in the end implies a higher productivity, quality and lower cost and faster production cycles. The paper describes the application of new technological processes (introduction of new protective gases for MAG welding, the use of anti-sticking metal drops and timely control of sections of the ship), resulting in the reduction of working hours of the production process, less time in the final section of lower cost manufacturing process of the ship.

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