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Centralized Lubrication System for Casting Complexes

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Abstract. To improve the operational reliability and ease of maintenance of foundry complexes, Rifar CJSC offers an individual supply of release lubricant for molds of foundry complexes to the centralized feeding system. A hydraulic circuit has been developed, the volume and design of a hydraulic tank for a concentrate made of sheet steel by welding has been determined. As a result of the development of a centralized separation lubricant supply system for molds of foundry complexes, it was possible to simplify the lubrication supply scheme, reduce fuel costs and reduce the complexity of maintenance. Replacing the individual supply of release lubricant to molds of foundry complexes with a centralized feed system increases the reliability of the supply of release lubricant to molds of foundry complexes. Calculations show that the implementation of design solutions does not require large capital expenditures, and as a result of the implementation of the proposed measures, the cost of production will decrease by 0.02%, the payback period of the proposed investment project does not exceed 1 month.

INTRODUCTION

Currently, metallurgical enterprises pay great attention to improving existing equipment, introducing new advanced technologies, fully automating the management of metallurgical processes using high-performance computer systems, improving the organization of labor and improving the skills of working personnel [1–11]. One of the important problems of the metallurgical industry is to increase the reliability of equipment, which is solved by modernizing or replacing obsolete equipment [12–28]. The article discusses the issues of introducing into the production of a device centralized for the supply of separation lubricant to the molds of casting complexes of Rifar CJSC.

Rifar is a domestic manufacturer of a new series of bimetallic and aluminum sector radiators of high quality. They are well operated in Russia and the CIS countries, both in autonomous heating systems for private houses and collective heating systems for cottage villages, and in central heating systems of multi-story and other buildings. Rifar radiators are well established in various Russian regions and CIS countries. High reliability of radiators provides the ability to maintain operability for a long time and will make it possible to create comfortable heat with any functional heating systems [29-30].

METHODS

In the foundry there is an Italian-made MTX-300 gas-fired gas furnace, in which aluminum is smelted and cast. High-quality aluminum alloy of Russian manufacturers, stable maintenance of a constant temperature, strict dosing of the metal volume minimizes the cost of production waste. For melt smelting, it is necessary to use aluminum ingots AK12M2 in accordance with GOST 1583-93. The ingots (ingots) and secondary waste (sprues and burrs) are loaded into the furnace by an automatic skip hoist, on the pins of which a loading trolley is put on. To achieve maximum furnace productivity, it is necessary to strictly observe the order and schedule of loading charge materials provided for by regulatory documents [31-32].

The manufacture of bimetal heating radiators is carried out using a hydraulic press OL – A 1200. The principle of the injection molding press is based on the forced filling of the working molding cavity with the melt and the

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formation of preforms under the pressure of the press piston moving in the pressing chamber filled with the melt. Unlike the chill mold, the working surfaces of the mold in contact with the casting do not have a refractory coating. This process leads to the need for short-term filling of the molds with the melt and the action on the crystallized casting of excessive pressure, hundreds of times more than gravitational. We implement this process on modern hydraulic machines and provide tens to hundreds of thousands of castings for various purposes per hour with high quality properties, low roughness in dimensions and surfaces corresponding to or as close as possible to the finished part (Figure 1).

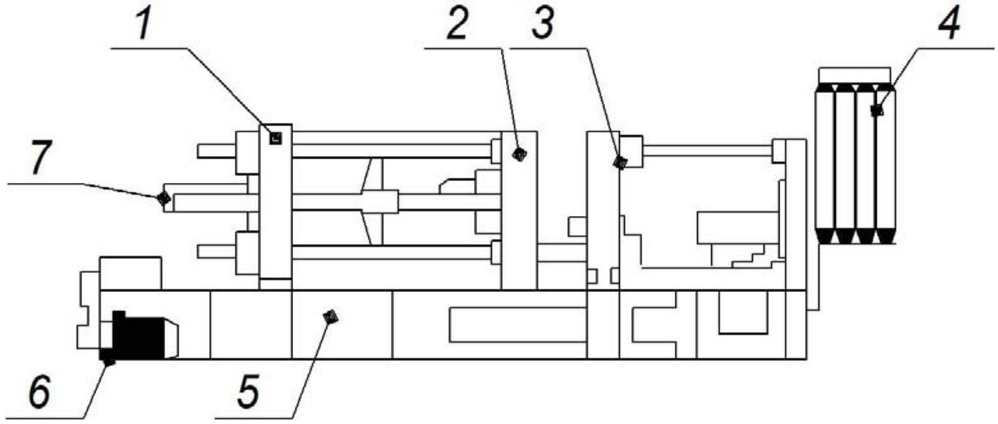

FIGURE 1. Injection molding device: 1 - plate; 2 - movable plate; 3 - fixed plate; 4 - hydroaccumulators; 5 - bed; 6 - hydraulic pumps; 7 - hydraulic cylinder.

For the smallest adhesion of the alloy to the walls of the molds (especially when casting aluminum), to reduce wear on the molds and to reduce seizure on the workpieces, mold lubrication with a release lubricant is used by the lubricating device shown in Figure 2. The parts of the pressing chamber (filling cup, piston, heel) are also lubricated.

To produce high-quality workpieces, grease must be applied in a thin layer. Excess grease drains into the pressing mold, and does not completely fill the mold contour and contributes to the formation of "frost". In addition, with a large amount of lubricant, the formation of bubbles increases, which creates additional pressure in the mold and leads to the formation of a flash on the castings. A fouling is part of the melt flowing in the plane of the connector and remaining on the casting.

It is necessary to lubricate places of the mold, to which the alloy may stick, and places that leave burrs or risks on the workpiece. Lubricating the rods and molds periodically, during working hours, depending on the shape of the casting. Complex molds need to be lubricated more often than simple ones. It is necessary to lubricate the parts of the chamber after several cycles of operation. When casting brass blanks, the first blanks after lubrication are discarded, since they are saturated with gas and are considered defective.

The best way to apply release lubricant to all working parts is to use a spray gun to provide a thin and even coating. Release lubricants used for molds must be resistant at high temperature and pressure, not cause corrosion of castings and parts of the mold, not be harmful to workers, form a stable film on the surface of the molds and the pressing chamber, are convenient for use [33-34].

A lubricating device is a unit of a casting machine designed to cool molds and lubricate their working surface with release lubricant. Consists of a nozzle block equipped with an injection system. The nozzle block is fixed to the bed, which moves along the vertical and horizontal axis with a certain speed, set by the operator through the control system. The mold is lubricated by an automatic lubricator spraying the FONDEROL FK – F – 002 [35] release lubricant onto the working surface of the movable and fixed part of the mold.

Obtaining quality products in the foundry department to a large extent depends on the preparation of the emulsion before use. A prerequisite is the correct ratio of the amount of concentrate in water. With an insufficiently concentrated emulsion, seizures on the workpieces or sticking of the molds will occur, and a large number of defective sections of aluminum radiators will be produced. A comprehensive solution to this problem is possible with the modernization of the emulsion feed of the foundry department of Rifar CJSC. Given the lack of material resources for technical re-equipment, special attention should be paid to the time spent on refueling intermediate concentrate tanks. In order to carry out the process of mixing the concentrate with water, an established dosing system is used, which allows to maintain the necessary concentration of release lubricant in the water.

At present, release lubricant for mold lubrication is being taken from an individual intermediate tank located near each foundry complex (Figure 2). At the same time, grease is refilled once, and it is used throughout the entire shift. After that, the tank with the help of forklifts is sent for refueling.

It is more preferable to use a centralized line for supplying separation lubricant to foundry complexes (Figure 3).

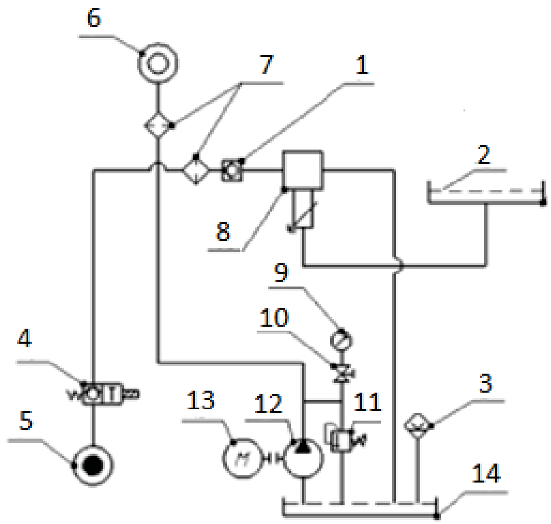

FIGURE 2. Diagram of individual supply of release lubricant to molds: 1 - check valve; 2 - hydraulic tank; 3 - level sensor; 4 - on-off distributor; 5 - hydraulic line; 6 - lubricating device; 7 - filter; 8 - dispenser; 9 - pressure gauge; 10 - valve; 11 - safety valve; 12 - hydraulic pump; 13 - electric motor; 14 - intermediate tank..

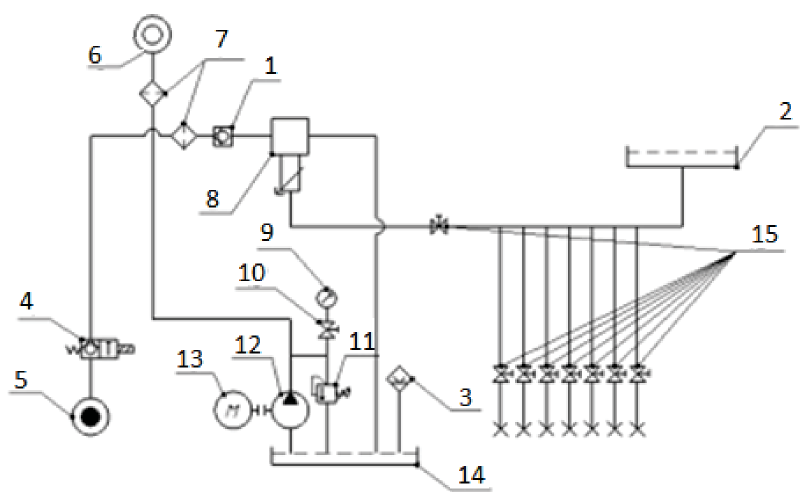

FIGURE 3. Diagram, of centralized supply of release lubricant to molds: 1 - check valve; 2 - hydraulic tank; 3 - level sensor; 4 - on-off distributor; 5 - shop line; 6 - lubricating device; 7 - filter; 8 - dispenser; 9 - pressure gauge; 10 - valve; 11 - safety valve; 12 - hydraulic pump; 13 - electric motor; 14 - intermediate tank; 15 - emergency valve.

This option is more commercially advantageous because there is no need to refuel each intermediate tank, which will help to reduce the time for refueling each individual intermediate tank. In addition, simplified quality control of the supplied emulsion [36].

The dispenser 8 is installed in the water supply network and uses the water pressure as a driving force, as a result of which it sucks the release lubricant from the hydraulic separation oil tank 2, doses it in accordance with the required percentage and then mixes it with the driving water. The resulting solution is sent to the intermediate tanks 14 installed at each foundry complex. From the tank 14 by a hydraulic pump 12, the solution is supplied to a lubricating device 6. Water for dosing is taken from the shop line 5. The hydraulic reservoir for separation grease has a liquid level sensor.

Separation lubricant consumption Q_{rl}, ml/min, is determined by the formula

$$Q_{rj} = C_{rl} \cdot Q_{water} = 20 \cdot 3.4 = 68 \text{ ml / min}. \quad (1)$$

Where: C_{rl} - amount of release lubricant in water, C_{rl} = 20 ml/l; Q_{water} - mixing water consumption, Q_{water} = 3.4 l/min.

$$V_{\tan k} = Z_f \cdot Q_{rl} \cdot T_{op} = 8 \cdot 68 \cdot 1440 = 783000 \text{ ml}. \quad (2)$$

The dispenser 8 is installed in the water supply network and uses the water pressure as a driving force, as a result of which it sucks the release lubricant from the hydraulic separation oil tank 2, doses it in accordance with the required.

Thus, it is proposed to use a tank with a volume of V_{tank} = 800 *l*, shown in Fig. 4. For the manufacture of the tank, any available material can be used, since the release lubricant is sufficiently inert and does not react with the surface of the tank. The manufacture of the tank is offered from steel sheet of grade St3 using manual arc welding. The load on the tank walls is small, therefore, a verification calculation can be omitted.

To supply the release lubricant from the tank to the dispenser, plastic tubes with an inner diameter of 4 mm and an outer diameter of 6 mm are used. The minimum diameter of the tube is determined based on the flow rate of the release lubricant and the velocity of the fluid outflow V_{rl} = 2 m/s.

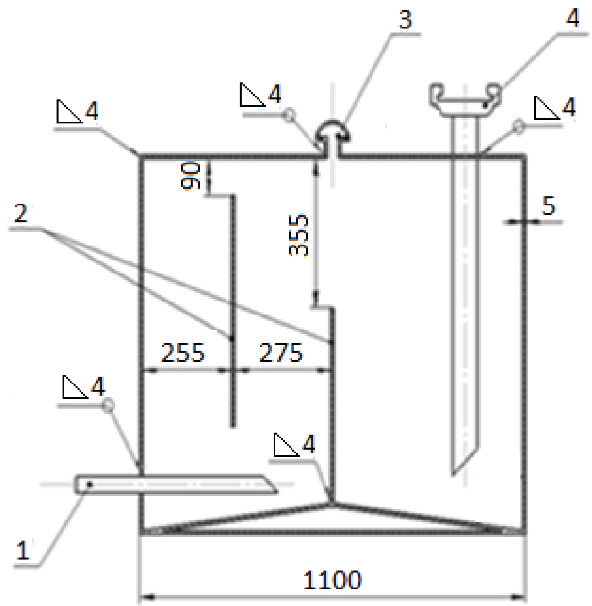

FIGURE 4. Hydraulic Concentrate Tank

DISCUSSION

To assess the economic efficiency of the introduction of a centralized emulsion supply, an estimate of capital costs was drawn up, as a result of which it was established that the amount of capital investments is about 80 thousand rubles. The main economic effect expected from the introduction of a centralized emulsion supply to foundry complexes is associated with a reduction in fuel consumption for forklifts. Prior to modernization, the company spent 9.66 million rubles for fuel. The proposed modernization measure will reduce these costs by 1.15 million rubles, which will have a beneficial effect on the economy of the enterprise, given the increase in fuel prices. As a result, the cost of one section of the battery decreased by 0.1 rubles (0.02%), which with a production volume of 11.5 million units. allowed to obtain a significant economic effect. The costs of introducing a centralized emulsion supply device will pay off after 25 days from the start of operation of the implemented device. These indicators prove the economic efficiency of the developed project.

CONCLUSION

A centralized emulsion supply to the casting complexes of Rifar CJSC was developed, which allowed to reduce fuel costs and reduce the time for filling hydraulic tanks with separation agent. The main elements of the hydraulic system were selected, the capacity was determined, and the design of the tank for the concentrate was developed. Calculations show that the implementation of design solutions does not require large capital expenditures, and as a result of the implementation of the proposed measures, the cost of production will decrease by 0.02%, the payback period of the proposed investment project does not exceed 1 month.

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