ISSN: 2350-0328
International Journal of AdvancedResearch in Science, Engineering and Technology
Vol. 11, Issue 2, February 2024

Method for assessing the durability of granules agglomerated welding fluxes against destruction

N.Z. Khudaykulov, M.M.Abralov

Associate Professor, Department of Technological machines and equipment, Tashkent State Technical University named after Islam Karimov, Tashkent, Uzbekistan
Associate Professor, Doctor of Philosophy in Technical Sciences (PhD), Department of Technological machines and equipment, Tashkent State Technical University named after Islam Karimov, Tashkent, Uzbekistan

ABSTRACT: The article describes a method for assessing the resistance of agglomerated fluxes against destruction, and also provides a device for its implementation. The proposed test methodology can be used to obtain data on the durability of agglomerated flux granules, which is one of the most important indicators of the welding and technological characteristics of welding fluxes.

KEY WORDS: agglomerated flux, granules, testing device, granulometric composition, resistance to destruction

I. INTRODUCTION

One of the features of granular fluxes, which contributes to their widespread use in the manufacture of metal structures and devices using arc welding, is the ability to reuse this welding material. It is known that in the process of loading flux into the hopper of a welding machine, welding and removing the remaining material from the surface of the welded joint, it is crushed, as a result of which the welding and technological properties of the flux deteriorate. Due to the increasing level of requirements for the quality of weld metal and the stability of the formation of welded joints, problems associated with the regeneration of fluxes have arisen. As a result, consumers of fluxes are interested in their ability to preserve the original granulometric composition, and manufacturers of this material are interested in increasing the resistance of flux granules against destruction during their transportation, storage and use. In this regard, the problem of developing an acceptable method for assessing the resistance of welding flux granules against destruction is urgent[1,2].

II. LITERATURE SURVEY

In accordance with ISO 14174–2004, fluxes, depending on the manufacturing technology, are divided into fused and agglomerated. These types of fluxes differ in bulk density and mechanical strength of the granules. Currently known methods for assessing the resistance of flux granules to destruction do not make it possible to obtain comparable results. For example, when testing fluxes for resistance to fracture in a rotating drum together with metal balls [1], the results obtained depend on the degree of filling of the drum with material. Therefore, it is difficult to compare fluxes if their bulk density differs by more than 10%. In addition, the conditions of this test do not simulate real situations in which flux granules are crushed, namely during their transportation, storage and use[3,4].

III. METHODOLOGY

Researchers have proposed a method for quantitatively assessing the resistance of flux granules to abrasion [2], which consists of transporting a dose of flux inside a torus-shaped vessel over a certain period of time due to a jet of compressed air supplied into the internal cavity and subsequent determination of changes in the granulometric composition of the flux. This assessment method quite adequately reproduces the conditions characteristic of the movement of the flux mass when it is removed using a flux pump after passing through the welding machine.

Experience with such equipment has revealed one significant drawback. Due to the considerable length of the path of movement of the flux sample inside the vessel (approximately 1 m), the pressure of the air stream cannot be maintained at a constant level along its entire length. As a result, if, when testing fluxes with a bulk mass of no more than 1.0 g/cm^3,

ISSN: 2350-0328
International Journal of AdvancedResearch in Science, Engineering and Technology
Vol. 11, Issue 2, February 2024

the granules moved inside the torus at an approximately constant speed, then with their significant (over 1.3 g/cm^3) bulk mass there are zones where the speed of flux movement is noticeable below. In the latter case, the test results do not provide an idea of the nature of the change in the particle size distribution of the flux under real conditions of the welding process.

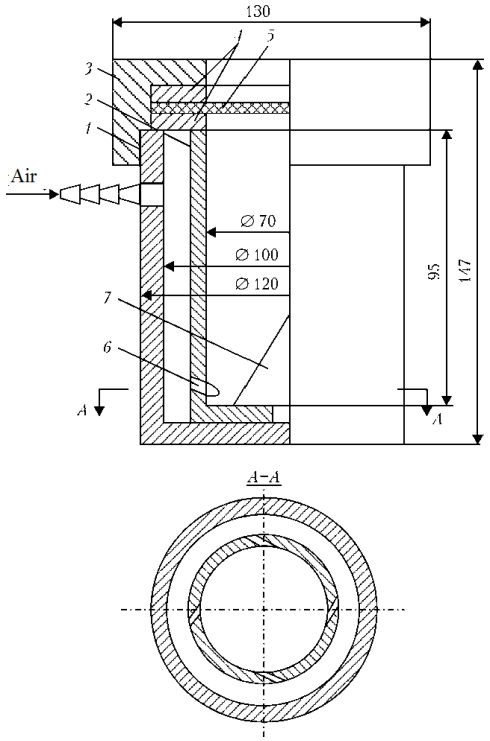

Fig.1. A device for assessing the resistance of flux granules to destruction.

In order to eliminate this drawback, certain changes were made to the design of the testing device (Fig. 1). In the improved model, the bulky torus-shaped vessel is replaced by a small-sized metal glass with a double wall. Compressed air is supplied into the gap between the walls under a certain pressure, which enters the inner chamber through several channels. Due to the uniform distribution of channels around the circumference of the chamber and their location at an angle to the generatrix, uniform movement of the flux mass in the metal cup is ensured throughout the entire test time.

To carry out tests, a sample of flux is poured into glass *2* . In the upper part of the device there is a metal mesh *5* with a cell size of 0.2 0.2 mm, which, after filling with flux, is pressed with the help of sealing gaskets *4* with a lid *3* to the body *1* . To maintain constant pressure in the installation, an autonomous compressor is used, which supplies compressed air to a container located between housing *1* and glass *2* . Compressed air through nozzles *6* is directed into the internal cavity of the glass, where, due to the tangential arrangement in relation to the generatrix of the glass surface, directed vortex air flows are created, under the influence of which the flux granules move in the internal volume of the glass, and the cone 7 installed in the center of this volume contributes to the concentration of all flux mass in the zone of highest speeds.

As the flux moves in the installation, its granules collide with the walls of the glass and with each other, thus reproducing the conditions in which the flux is found when it moves through the flux pump . Carrier air flows provide a high intensity of such influence, as a result of which the test time is reduced. As a result of abrasion, the flux granules in the internal volume of the glass are partially destroyed, and the resulting dust-like fraction less than 0.2 mm in size is removed along with compressed air flows through the mesh 5. A sample of the flux remaining in the device after completion of the test is weighed, and then the resistance to destruction (RD) of its granules is determined using the formula

$$RD = 100 - \left(\frac{M_1 - M_2}{M_1} 100\right)$$

ISSN: 2350-0328
International Journal of AdvancedResearch in Science, Engineering and Technology
Vol. 11, Issue 2, February 2024

M_1, M_2 — weight of flux sample before and after testing, respectively, g.
The setting parameters for this test process are the mass of the flux sample, compressed air pressure and test time. As a result of experiments, it was established that for an installation with the design dimensions shown in the diagram, the greatest reproducibility of results while maintaining high efficiency of analysis can be obtained with the following test parameters: sample mass (30 ± 5) g; compressed air pressure ±1 kPa; test time (10 ± 1) min.

IV. EXPERIMENTAL RESULTS

In Fig. Figure 2 presents the results of RD tests of agglomerated fluxes made with different mass fractions of binder and calcined at different temperatures. As is known, the technology for manufacturing fluxes of this type is based on the irreversibility of the dehydration process of the liquid glass binder during heat treatment. The final product of dehydration of liquid glass is a silicate frame, the strength of which determines the resistance of the flux granules to destruction. The mass fraction *C* of the dry residue of liquid glass introduced into the flux charge and the heat treatment temperature of the flux, all other things being equal, are the key factors affecting the resistance of flux granules against destruction.

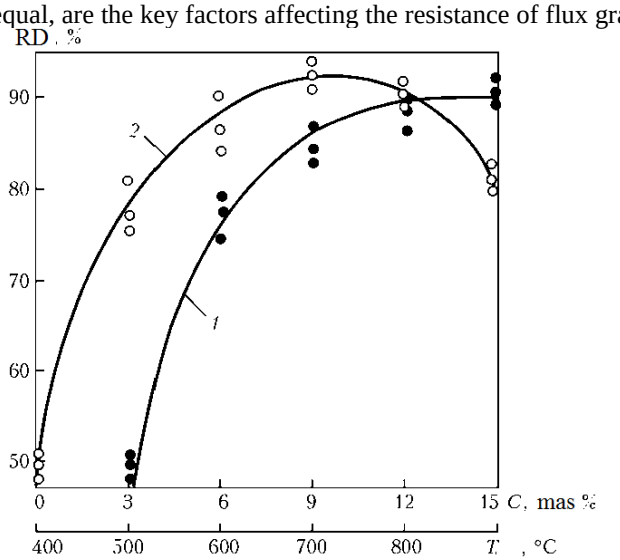

Fig.2. The influence of the dry residue content of liquid glass and heat treatment temperature on the resistance of its granules against destruction.

In Fig. 2, curve *1* is plotted based on the results of testing using the developed method of agglomerated flux of aluminate -basic type, into the charge composition of which different contents of dry liquid glass residue were introduced as a binder for the formation of flux granules. After granulation, the flux was calcined at a temperature of 650 °C. The mass fraction of liquid glass was controlled based on the content of its dry residue in the flux composition.
Curve *2* , constructed for a flux of the same composition, but containing 10 wt . % dry residue of liquid glass indicates the influence of the heat treatment conditions to which it was subjected after the granulation operation on the RD of its granules.

V. CONCLUSION

The data obtained are consistent with the information available in the literature on the effect of the content of liquid glass binder and the processing temperature of agglomerated fluxes on the RD of their granules and show good stability of the results obtained when testing fluxes using the described method.

Thus, the developed methodology and the device for its implementation can be successfully used to evaluate the SPR of flux granules - one of the most important indicators of the welding and technological characteristics of fluxes.

ISSN: 2350-0328
International Journal of AdvancedResearch in Science, Engineering and Technology
Vol. 11, Issue 2, February 2024

ACKNOWLEDGMENT

This work was carried out within the framework of a business agreement with the Tashkent Pipe Plant named after V.L. Galperin No. 1/2022 on the topic: "Research and development of the composition of ceramic fluxes for automatic arc welding of low-carbon and low-alloy steels".

REFERENCES

[1]. Wegman E. F., Bocharov L. N., Matyukhin B. P. Machines and instruments for testing materials – Moscow, Metallurgy, 1971. - 120 p.
[2]. Method for quantitative assessment of the resistance of flux granules anti-abrasion// First International Conference on the problem "Welding" - 1984. – Issue 25. pp. 76–77.
[3]. Khudaykulov N.Z., Abralov M.M., Yusupov B.D. Investigation and Selection of a Surface Electrode with Improved Properties for Restoration of Worn Parts of Machines from Steel 110G13L// International Journal Of Advanced Research in Science, Engineering and Technology - India, 2023. – Vol.10, № 5 (May). – pp. 20645 – 20648.
[4]. Nurilla K., Muzaffar A. On the question of use of agglomered welding flux in the formation of weld metal during arc welding of low-alloyed high-strength steels //Universum: технические науки. – 2023. – №. 3-4 (108). – pp. 47-50.
[5]. Khudaykulov N.Z. Development of composition and production technology alloying ceramic flux// II-International Scientific and Scientific-Technical Conference on Innovative techniques and technologies agriculture ─ in the food network problems and prospects. April 2022. pp. 140-142.

AUTHOR'S BIOGRAPHY

	**Khudaykulov Nurulla Zikirillayevich.** Associate Professor, was born June 3, 1972 year in Tashkent city, Republic of Uzbekistan. Has more than 35 published scientific works in the form of articles, journals, theses and tutorials. Currently works at the department of "Technological machines and equipment" in Tashkent State Technical University.
	**Abralov Muzaffar Makhmudovich**, Associate Professor, Doctor of Philosophy in Technical Sciences (PhD), was born March 4, 1978 year in Tashkent city, Republic of Uzbekistan. Has more than 50 published scientific works in the form of articles, journals, theses and tutorials. Currently works at the department of "Technological machines and equipment" in Tashkent State Technical University.