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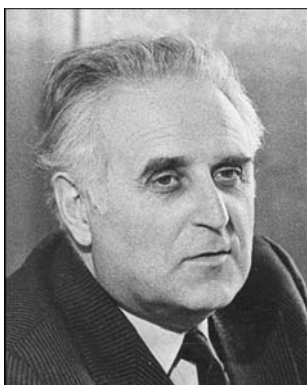
Developed at PWI 44



DEPARTMENT FOR INVESTIGATIONS OF PHYSICAL-CHEMICAL PROCESSES IN THE WELDING ARC IS 50 YEARS

I.K. POKHODNYA

E.O. Paton Electric Welding Institute, NASU, Kiev, Ukraine



Rapid development of machine building, construction and other industries of the Soviet Union in the post-war years required elaboration and investigation of new consumables for welding of different grades of structural steels. Also, it was necessary to build new plants for industrial production of general- and special-application covered electrodes with improved sanitary-hygienic properties.

B.E. Paton made a decision to organise a new-level research into metallurgical and electrophysical problems of arc welding, as well as development of low-toxicity electrodes and technologies for their commercial manufacture. A new laboratory was arranged at the E.O. Paton Electric Welding Institute of the Ukr. SSR Academy of Sciences in 1958 to address these problems, the author of this article being appointed a head of this laboratory.

The laboratory completed a number of studies in the 1960s. An ingenious method for high-speed X-ray photography of fast processes was developed. The reliable data on the processes of melting and transfer of electrode metal in covered-electrode, underwater and submerged-arc welding were generated with the help of this method. The principles of kinetics of melting and transfer of electrode metal, distribution of temperature in the electrode metal drops, processes of heat exchange between the arc and molten metal at the electrode tip, processes of absorption of gases by the molten metal under the arc discharge conditions, as well as the patterns of distribution of hydrogen and nitrogen in the weld pool with the continuously moving interface between the liquid phase and solidifying metal were studied.

The mechanisms of the effect of welding parameters, density and polarity of the welding current on temperature of the drops, time of interaction of the drops with the environment, and type of a covering on the process of melting and transfer of electrode metal in covered-electrode welding were revealed. Relationship of the density and polarity of the welding current to temperature of the electrode metal drops, voltage gradient in the arc column and electrode metal transfer was determined.

Finding the principles of the processes of gas absorption and desorption allowed the new approaches to be used to interpretation of the mechanism of formation of porosity in the welds (I.K. Pokhodnya, A.M. Suptel, I.R. Yavdoshchin, G.G. Koritsky, A.P. Paltsevich, V.N. Gorpenyuk, B.A. Kostenko).

Results of these studies were presented in book «Gases in the Welds» by I.K. Pokhodnya, which was published in the USSR in 1972 and later re-published in the Czechoslovak Socialist Republic and in China. They served as a theoretical base for the development of many grades of advanced low-toxicity and high-efficiency welding electrodes characterised by favourable welding-operational properties, providing a dramatic reduction of harmful emissions and good mechanical properties of the weld metal. Coverings of the electrodes had original compositions, and were protected by author's certificates of the USSR and foreign patents.

To arrange mass, highly mechanised production of electrodes, it was necessary to design and build new high-capacity workshops. Short terms were allocated to accomplish this national economy task.

In 1962, the E.O. Paton Electric Welding Institute arranged the experimental production of welding electrodes, which made it possible to dramatically reduce the time from emergence of a scientific idea to its wide practical application (V.L. Borisyuk, L.F. Belozyorov).

In June 1962, the electrode laboratory was re-organised into the Department for Investigations of Physical-Chemical Processes in the Welding Arc, the efforts of which were highly esteemed both in the USSR and abroad.

A.E. Marchenko, I.R. Yavdoshchin and A.M. Benjish conducted investigations at the E.O. Paton Elec-