

STATE-OF-THE ART AND TENDENCIES IN DEVELOPMENT OF WELDING ELECTRODE MARKET IN UKRAINE

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Welding as the main technology of joining materials is an intrinsic component of the industrial sector of economy, integrated into production process of basic industries. The paper presents systematized economic-statistical information about the state-of-the art and development of welding electrode market in Ukraine, the indices of their production volumes and export-import operations. Capacities of Ukrainian manufacturers allow both satisfying the demand for welding electrodes in the internal market, and supplying their products to the external market. 12 Ref., 3 Tables, 11 Figures

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Processes of globalization in the world and their influence on internal markets necessitate performance of studies of welding equipment market in Ukraine, in order to identify promising directions of development of welding production in view of its high importance to national economy, as welding as a method to produce permanent joints of metals and non-metals is the basic technology in many industrial sectors and in construction.

Economic-statistical analysis of the state of world and regional markets of welding equipment in Ukraine and prospects for their development is given in [1–7]. These investigations allow finding optimum ways for successful functioning of Ukrainian manufacturers to satisfy the demand for their products under the conditions of tough competition not only in external, but also in the internal markets. To ensure stable functioning of Ukrainian manufacturers of welding materials under these conditions, it is necessary to quickly respond to constantly changing requirements of the users through improvement of the already manufactured products which are in demand in the market and developing new ones [8, 9]. An important element in

planning the enterprise activity is evaluation of the competitiveness of the produced welding materials in each area of their application [10].

Welding materials manufacturing is the leading component of welding production in Ukraine. Capacities of Ukrainian enterprises-manufacturers of welding materials, in particular, welding electrodes, allow both satisfying internal market needs, and supplying their products to external markets [11]. This is promoted by availability of raw material base for producing general-purpose electrodes, used for welding carbon and low-alloyed steels (ANO-4, ANO-21, MR-3 grades with rutile coating, as well as electrodes with basic coating of UONI-13 type). This is due to the fact that their products were in demand in many enterprises of mechanical engineering complex, in construction and other spheres of production (Figure 1). Demand for special electrode grades for welding in power engineering, welding of pipelines, high-alloyed steels, non-ferrous metals, cast iron and for surfacing operations during Soviet times was satisfied mainly by supplies from Russia.

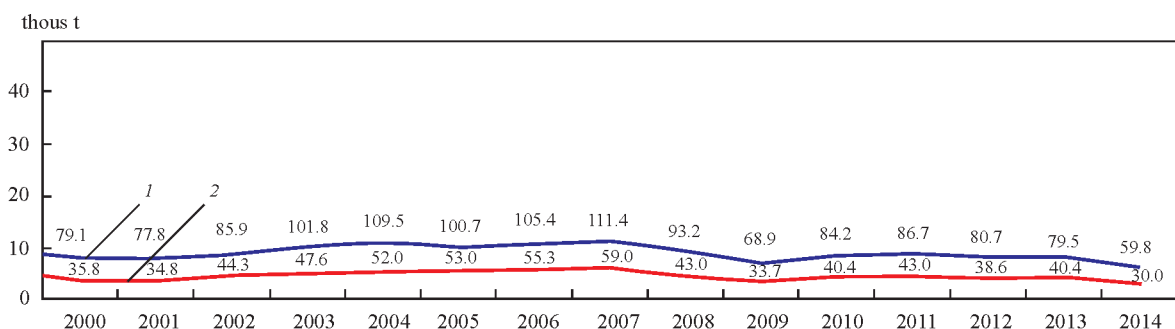


Figure 1. Dynamics of welding material and electrode production: 1 — WM production volume; 2 — electrode production volume; 1990 — 429.9 (WM), 162.4 (welding electrodes); 1995 — 93.4 and 54.2, respectively

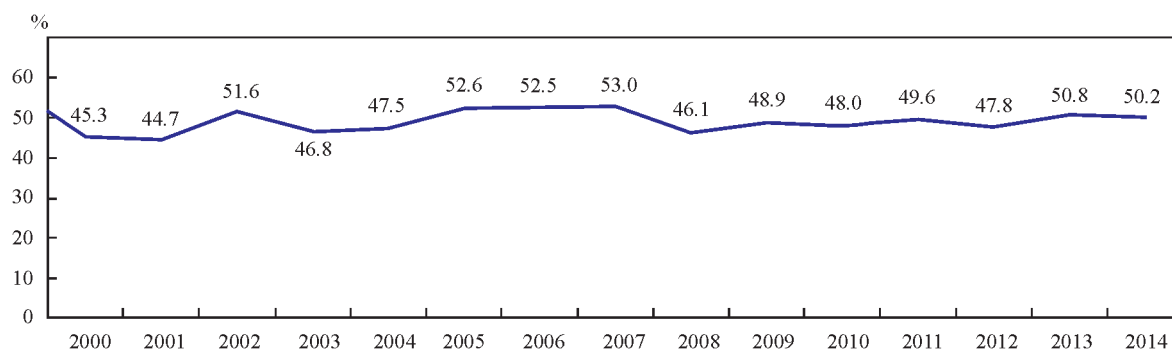


Figure 2. Share of welding electrodes in overall volume of welding material production; 1990 — 37.88, 1995 — 58 %

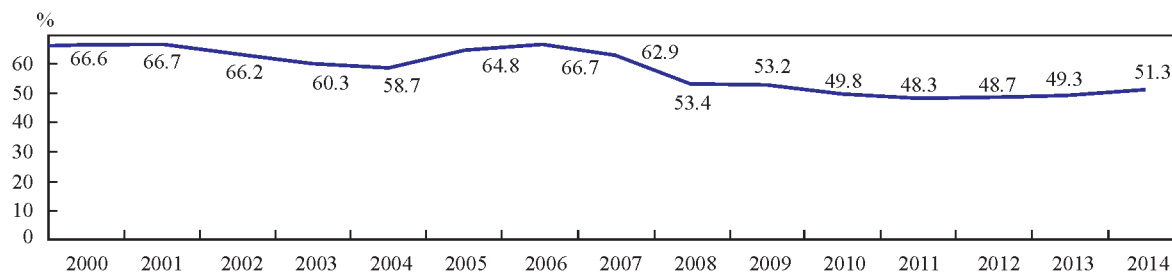


Figure 3. MAW share (by deposited metal); 1990 — 41.98; 1995 — 65.1 %

Long-term economic crisis in CIS countries led to a considerable reduction of the volumes of welding material production, including welding electrodes. Starting from 1995, the scope of production of welding materials and electrodes was stabilized in the new range. During the years of growth of industrial production in Ukraine and CIS countries (main sales markets) the output of welding materials and welding electrodes increased. During the years of economic and financial crisis a decline of production of welding materials and electrodes was observed, both in Ukraine, and in the world. Such an almost synchronous change of production volumes was caused by that the proportion of welding electrodes material the

main part of welding material output structure (Figure 2).

Increase of the proportion of welding electrode output is related to increase of the scope of work, performed using manual arc welding (Figure 3), in connection with the change in the structure of industrial production (Table 1), namely reduction of the share of mechanical engineering (to 6.4 %), as a result of reduction in the output of key product kinds (Table 2), in manufacturing of which automatic and mechanized welding is extensively used. With stabilization of economic processes in the country and growth of industrial production the share of manual arc welding by deposited metal somewhat decreases, but it remains

Table 1. Proportion of the main industries in overall scope of production, %

Industry	1990	1995	2000	2005	2008	2010	2012	2013	2014	2015
Power generation	3.2	11.0	15.2	15.9	17.8	21.3	24.5	24.6	24.6	21.9
Mining and metallurgical complex	12.1	23.4	29.8	30.4	31.4	28.9	26.5	26.1	27.4	29.6
Mechanical engineering	30.5	16.0	13.4	12.7	13.3	10.9	10.2	10.0	7.2	6.4
Light industry	10.8	2.8	1.7	1.1	0.9	0.8	0.7	0.7	0.8	0.9
Food industry	18.6	15.1	17.7	16.3	15.2	18.1	18.2	18.5	21.2	21.8

Table 2. Output of some industrial products

Product type	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015
Finished rolled stock; mln. t	38.6	16.6	22.6	32.2	29.2	31.0	29.3	29.1	23.8	21.3
Steel pipes, mln. t	6.5	1.6	1.7	2.4	2.0	2.4	2.3	1.8	1.6	1.0
Metal cutting machines, thous. pcs	37.0	6.0	1.3	0.4	0.1	0.1	0.1	0.1	0.07	0.04
Press-forming equipment, thous. pcs	10.9	1.4	0.4	0.1	0.05	0.022	0.051	0.011	0.007	0.008
Welding equipment, thous. pcs	49.6	18.3	16.2	25.4	16.9	18.1	22.8	18.2	13.0	—
Excavators, thous. pcs	11.2	2.3	0.2	0.6	0.11	0.12	0.08	0.05	—	0.03
Tractors, thous. pcs	106.0	10.4	4.0	5.5	5.2	6.4	5.3	4.3	4.1	4.2
Cars, buses, thous. pcs	196.0	67.4	31.9	196.6	82.9	104.4	73.3	50.4	26.8	—
Precast concrete, mln. m ³	23.3	5.6	2.0	3.2	1.9	2.3	2.1	2.0	1.9	1.7

Table 3. Application of arc welding processes, % (by deposited metal)

Country	Welding process	1965	1975	1985	1995	2000	2005	2012	2015
Western Europe	MAW		58	34	18	15	12	8.9	10
	CO ₂	74	31	56	70	71	75	63.9	56
	FCW		2	3	6	6.5	6.5	19.1	22
	ASAW		9	7	6	7.5	6.5	8.1	13
USA	MAW		53	42	25	19.5	15	10.3	11
	CO ₂	71	25	38	54	54	58.5	61.4	56
	FCW		13	13	19	19	19.5	22.1	23
	ASAW		9	7	7	7.5	7	6.2	10
Japan	MAW		67	44	22	14	12	7.3	8.8
	CO ₂	85	20	39	52	54	54.5	49.5	45.9
	FCW		1	11	25	25	27	35.9	35.1
	ASAW		9	10	7	7	6.5	7.3	10.2
Ukraine	MAW	63	52.4	44.9	65.1	66.6	64.8	48.9	
	CO ₂	9.5	23.7	35	26.5	23.3	16.1	32.5	
	FCW	0.5	3.2	3.4	0.9	0.5	3.2	1.4	
	ASAW	27	20.7	16.7	7.5	9.6	15.9	17.2	

Note. MAW — manual arc welding, CO₂ — gas-shielded welding; FCW — flux-cored wire welding, ASAW — automatic submerged-arc welding.

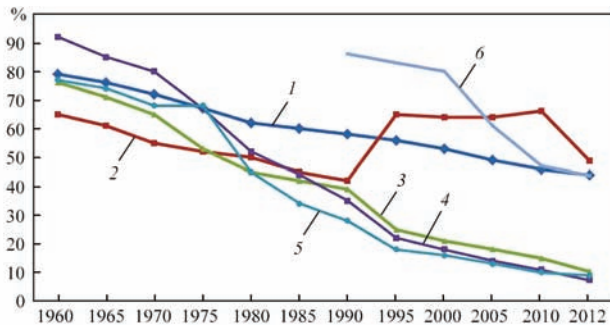


Figure 4. Share of manual arc welding in the world countries (% by deposited metal): 1 — RF; 2 — Ukraine, 3 — USA; 4 — Japan; 5 — Western Europe; 6 — China

high, compared to economically developed countries (Tables 3 and Figure 4).

Data given in Figure 4 show that the proportion of manual arc welding in Ukraine, which was equal to 64 % in 1965, was lower than that in economically developed countries (80–90 %). By 1990 it was on the

level of 42 % that is comparable with the indices for the USA and Japan. Over the recent years, the share of manual arc welding in Ukraine increased significantly for the above reasons. Wide application of MAW also influenced the scope of welding electrode market: volume of their production and consumption in Ukraine increased (see Figures 2 and 3).

Figure 5 presents the dynamics of production, export, import and apparent consumption of welding electrodes in the internal market. The basic needs for electrodes of mechanical engineering enterprises and construction are satisfied by their production by Ukrainian manufacturers. At present 14 welding electrode manufacturing enterprises are really operating in Ukraine, although in 1990s their number was up to one hundred. The main manufacturers currently are: PJSC «Plasmatek» (Vinnitsa), Mashzavod «Pobeda truda» Vistek (Bakhmut, Donetsk region), «Sumy-Electrode» Ltd. (Sumy), PWI Pilot Plant of

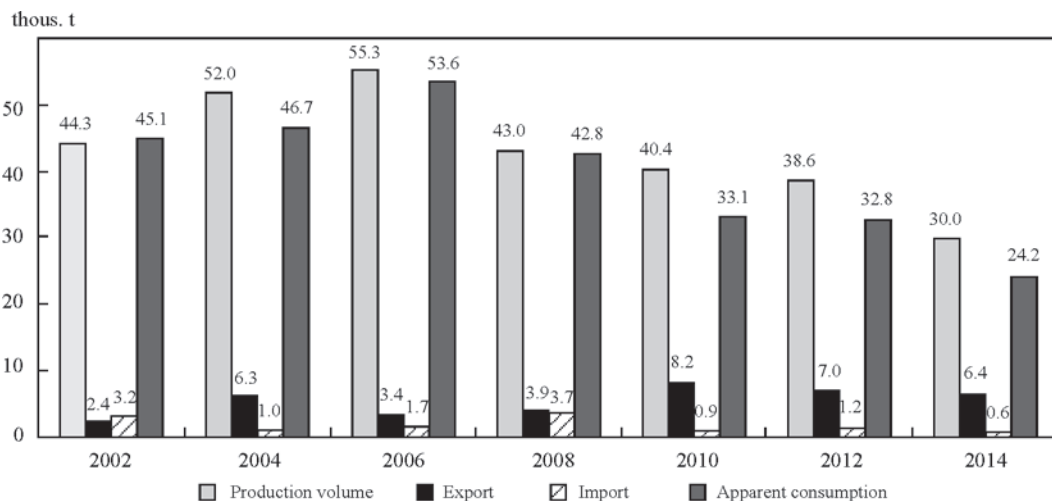


Figure 5. Scope of domestic consumption of electrodes in Ukraine, thous. t

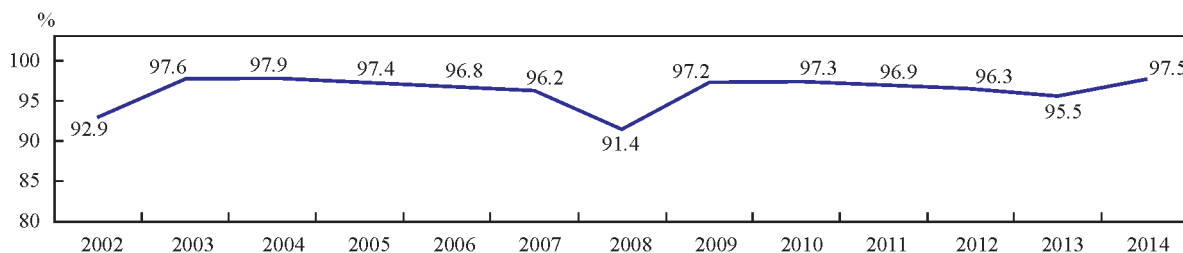


Figure 6. Share of Ukrainian manufacturers in the internal market

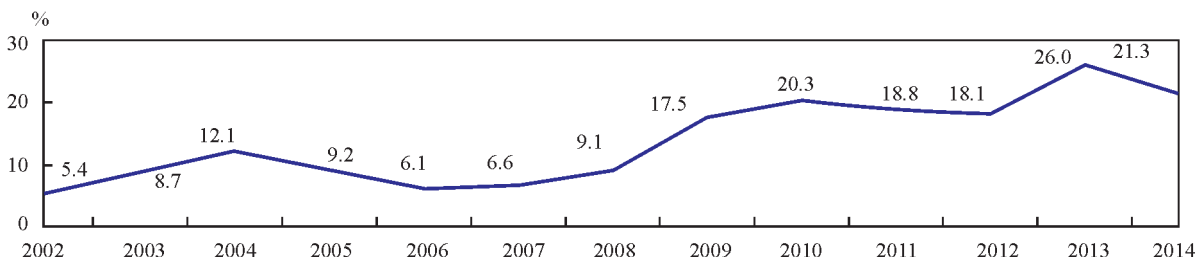


Figure 7. Export share in overall production volume

Welding Consumables (Kiev), «Galelektroservis» Ltd. (Lvov), «II BadmAtd» (Dniepr), «Gansa» Ltd. (Krivoj Rog).

Ukrainian manufacturers take up leading positions in the internal market. Their share in the internal market is higher than 90 % (Figure 6).

Dynamics of exports share in the overall volume of welding electrode production for 2002–2014 [12] is shown in Figure 7. Export volumes largely depend on economic condition in the main regional sales markets. During the years of growth of industrial production the demand for products of Ukrainian manufacturers grows in these markets, and volumes of export operations are increased, respectively. Due to devaluation of the national currency (hryvnia) during the years of financial crisis, Ukrainian products become more marketable and competitive that promotes export.

From 2002 till 2014 the import share in internal market structure was equal to about 4 %, on average, but in some years this figure was up to 8.6 %.

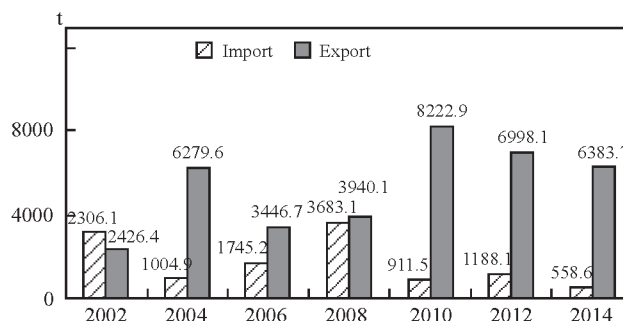


Figure 8. Dynamics of export-import of welding electrodes

Dynamics of export-import operations in the product group of welding electrodes is shown in Figure 8. Volumes of export supplies of welding electrodes are much larger than those of import. This ensures a positive foreign trade balance in this product group, and electrode manufacturing plants promote foreign currency flow into the country and maintenance of hryvnia rate.

The main regional associations on export-import operations are CIS and EU countries. These countries

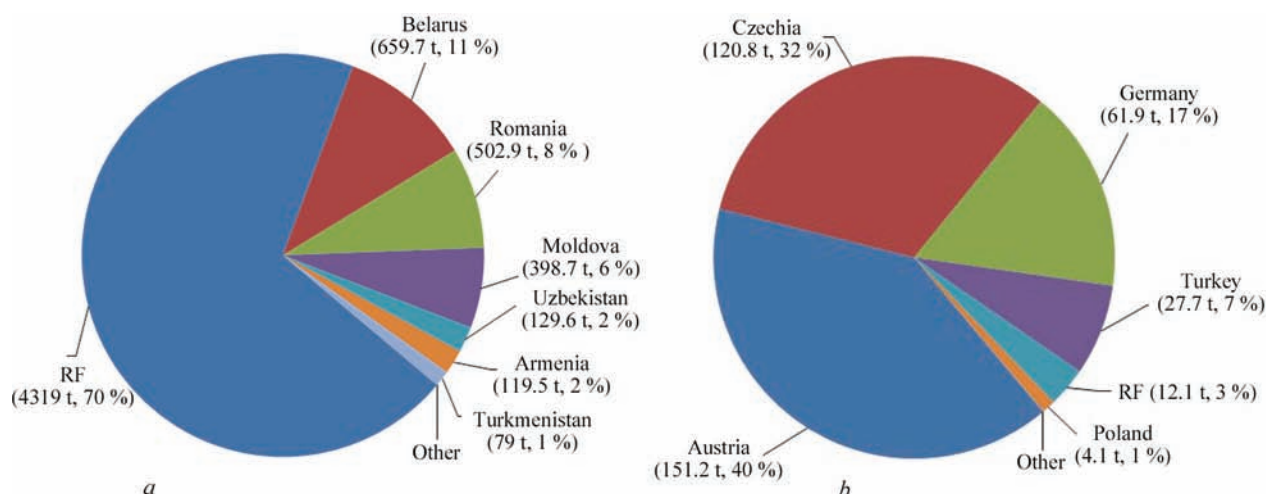


Figure 9. Geography of export-import operations in product group of welding electrodes for 2015: a — export; b — import

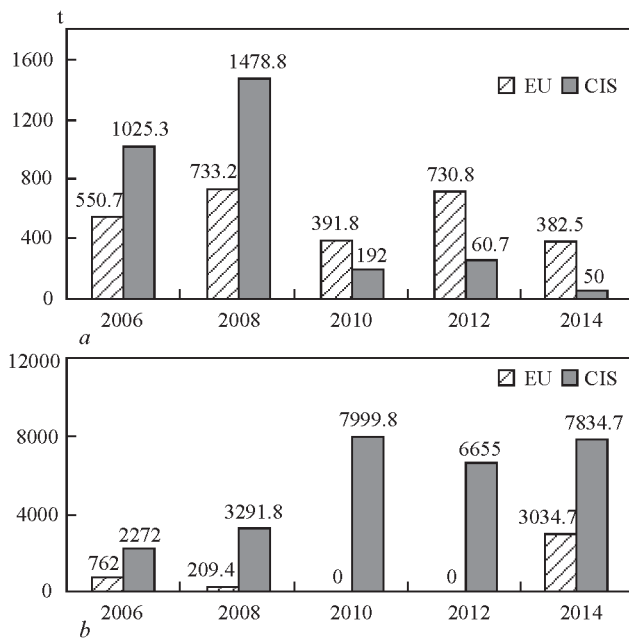


Figure 10. Dynamics of export-import operations with CIS and EU countries; *a* — import; *b* — export

account for 70–90 % of export-import volume (Figure 9). Dynamics of export-import operations with CIS and EU countries is shown in Figure 10.

CIS countries are the main region for export of Ukrainian manufacturing plants. Such plants as «Plasmatek» and «Sumy-Electrode» became the leading exporters. General purpose electrodes of UONI 13/45, UONI 13/55, MR-3, ANO-4, ANO-21, and ANO-36 grades are mainly supplied to the markets of these countries. Proportion of special electrodes is relatively small and includes four electrode grades for welding high-alloyed steels — TsL-11, OZL-18, EA-400/10U and EA-395/9, two grades of electrodes for cast iron welding — TsCh-4 and MNCh-2 and two surfacing electrode grades T-620 and T-590.

Volume of import from these countries in 2009–2014 decreased significantly and became an order of magnitude smaller than export indices. Mostly special purpose electrodes are imported. Reduced imports became possible as a result of import substitution of a number of electrode grades. The majority of plants have mastered production of special grades of welding electrodes, but their share in the general product volume grows, and is becoming the dominant one in some enterprises («Sumy-Electrode» Ltd., «Gefest», WeldingTek). PJSC «Plasmatek» and «Sumy-Electrode» Ltd. developed and put into production several grades of electrodes with rutile coating for welding high-alloyed steels, which correspond to the best foreign analogs.

Over the recent years leading enterprises of Ukraine developed and mastered production of mod-

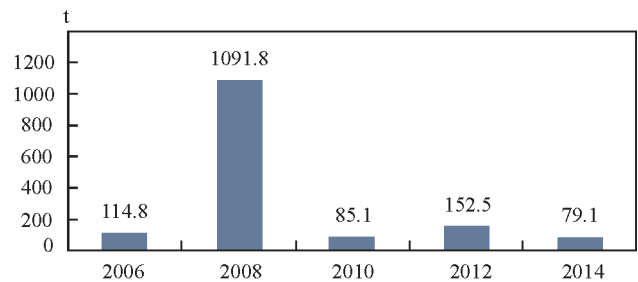


Figure 11. Dynamics of welding electrode supplies from China
ern electrode grades with rutile and basic coating, which in terms of quality correspond to the level of the best foreign grades (ANO-36, Monolit RTs, MD6013, Proton E6013, UONI-13/55 Plasma, etc.).

Starting from 2009, EU countries account for a considerable volume of import in product group of welding electrodes. The main suppliers are leading world companies, such as ESAB and BOHLER, which mainly supply high-quality electrodes for pipeline welding (OK 53.70, OK 74.30, FOX EV560, FOX PIPE, Phoenix 7018), which are not available in Ukraine, as well as electrodes with rutile coating for welding high-alloyed steels, having excellent welding-technological properties. Ukrainian analogs of these electrodes (for instance, TsL-11, OZL-8, etc.) are significantly inferior to them by their welding-technological properties.

Dynamics of supply of welding electrodes from China in 2005–2008 should be noted. Annual increase of import during this period was equal to 250–600 % (Figure 11). After a sharp drop in welding electrode sales in 2009, by 2013 the volumes of import practically reached the pre-crisis period indices. Mainly general purpose electrodes of ANO-21 type (E6013 type to AWS) were supplied from China. Due to a low content of manganese in the metal deposited with above-mentioned electrodes, however, the users had some complaints against them. Owing to hryvnia devaluation, supplies of welding electrodes from China have practically ceased.

Known Turkish Companies «ASKA-NYAK» and «GEDIK» performed supplies of general purpose welding electrodes with rutile and basic coating, as well as electrodes with rutile coating for welding high-alloyed steels, and electrodes for welding cast iron and copper. The above electrodes have a good balance of quality and cost.

Decline in industrial production in Ukraine in 2014–2015 as a result of political and economic crisis, led to a drop in demand for welding electrodes, and to reduction in their supplies from EU countries, Turkey and China, respectively.

Conclusions

Welding is a leading technological process in Ukrainian industry, and the national market of welding electrodes is developing dynamically.

Production capacities available in Ukraine allow satisfying the domestic needs of mechanical engineering enterprises for most of the items in product group of welding electrodes.

Further stable and effective development of welding electrode production and improvement of their competitiveness is possible at application of the results of fundamental and applied research, available high potential, active transfer of high welding technologies and other innovations.

1. Bernadsky, V.N., Mazur, A.A. (1999) State-of-the-art and prospects of world welding market. *Avtomatich. Svarka*, **11**, 49–55.
2. Bruno Pekkari (2006). *Svetsaren*, **3**, 12–16.
3. Bernadsky, V.N., Makovetskaya, O.K. (2007) Welding fabrication and welding equipment market in modern economy. *The Paton Welding J.*, **1**, 35–39.
4. Makovetskaya, O.K. (2011) Modern market of welding equipment and materials. *Ibid.*, **6**, 18–32.
5. Makovetskaya, O.K. (2012) Main tendencies at the market of welding technologies in 2008–2011 and forecast of its development (Review). *Ibid.*, **6**, 32–38.
6. Zadolsky A.N., Pin Ma (2009) Review of welding production market in Ukraine. *Biznesinform*, **5**, 33–39.
7. Middeldorf, K., Hofe, D. von (2009) Tendencies of development of material joining technologies. *Mir Tekhniki i Tekhnologij*, **11**, 12–16.
8. Yavdoshchin, I.R., Folbort, O.I. (2011) New information on «old» electrodes. *The Paton Welding J.*, **1**, 48–49.
9. Marchenko, A.E., Skorina, N.V., Kostyuchenko, V.P. (2011) State-of-the-art of development and manufacture of low-hydrogen electrodes with double-layer coating in CIS countries (Review). *Ibid.*, **1**, 41–44.
10. Shlepakov, V.N. (2011) Current consumables and methods of fusion arc welding (Review). *Ibid.*, **10**, 26–29.
11. (2015) *Economic-statistic review of welding production and market of welding equipment of Ukraine in 1990–2014*. Kyiv: PWI.
12. *Foreign economic activity of Ukraine in 2002–2015*. Kyiv: PWI.

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