STATE-OF-THE-ART AND TENDENCIES OF DEVELOPMENT OF WORLD MARKET OF THE MAIN STRUCTURAL MATERIALS AND WELDING EQUIPMENT*

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The paper provides for statistical and economical indices of state and tendencies of development of world market of the main structural materials and welding equipment in the period of 2011–2014. Presented are the results of researches of world volume, structure of production and consumption steel, aluminum etc., and volume of production and consumption of welding equipment. These researches were carried out by leading world manufacturers such as Lincoln Electric, Colfax (ESAB, Victor Technologies Group), ITW etc. as well as leading analytical companies BCC Research, Transparency Market Research, Frost & Sullivan. Analysis of main tendencies of world market of welding equipment and its separate segments is given. 19 Ref., 2 Tables, 12 Figures.

Keywords: *world market, production, consumption, main structural materials, welding equipment, statistics*

Market of the main structural materials. Period of stabilizing and economic growth has started in the world in 2013. The USA and EU showed the highest rate of economic activity. Chinese economy shifts from an export model to development on the basis of growth of internal consumption. Recovery of the world economy promoted increase of demand on structural material markets. Among the main structural materials of current commercial production are ferrous and non-ferrous metals, nonmetallic materials (plastics, ceramics, glass etc.) and composite materials.

Volume of consumption of the structural materials is continuously growing. World production of the main structural materials, which are most widely used in welded structure production, has increased within the last five years. Steel, structural plastics and composite materials grew per 22, aluminum rose per 24 and titanium per 27 %.

In 2013 the volume of world market of structural plastics made 299 mln t and was estimated in USD 70 bln. It is predicted that the volume of market of structural plastics will achieve USD 90 bln [1] by 2020. Half of the world production and consumption of thermoplastics falls to EU countries and USA. Thermoplastics finds more and more application in automobile and building industry, in part structures for airspace industry, machine building, power engineering, including windpower engineering [2, 3].

It is rise of consumption of non-ferrous metals in industry. Volume of world production of primary aluminum made 49.7 mln t in 2013 that is 6 % higher than the indices of 2012, world production of primary aluminum has risen per 4.8 % more up to 53.1 mln t in 2014. It is predicted that production of primary aluminum will exceed 62 mln t by 2017. The main aluminum consuming branches are motor car construction and building. Their total portion exceeds 50 % in total volume of the world consumption of primary aluminum. Motor car construction (Japan — 43, USA, Western Europe — 35 %) and machine building (Western Europe, Japan — 19, USA — 15 %) [4] dominate as for consumption of aluminum in branch structure of industrially advanced countries, i.e. USA, Japan, and Western Europe.

Figure 1 shows the data on production volumes of the main structural materials in 1970, 2008 and 2013.

Position of titanium as key material in aircraft and space industry guarantees growth of this metal consumption. Steady growth of demand for industrial grade titanium is observed in the period of 2010–2011 in China. «Airbus» and «Boeing», the world leaders of aircraft construction, recommence postponed programs on construction of A380 and B787 airplanes as well as new A350, that resulted in rise of demand for grade of titanium to be applied in space. The world market

*Review of materials from collection of economical-statistical data on welding production «SVESTA-2014».

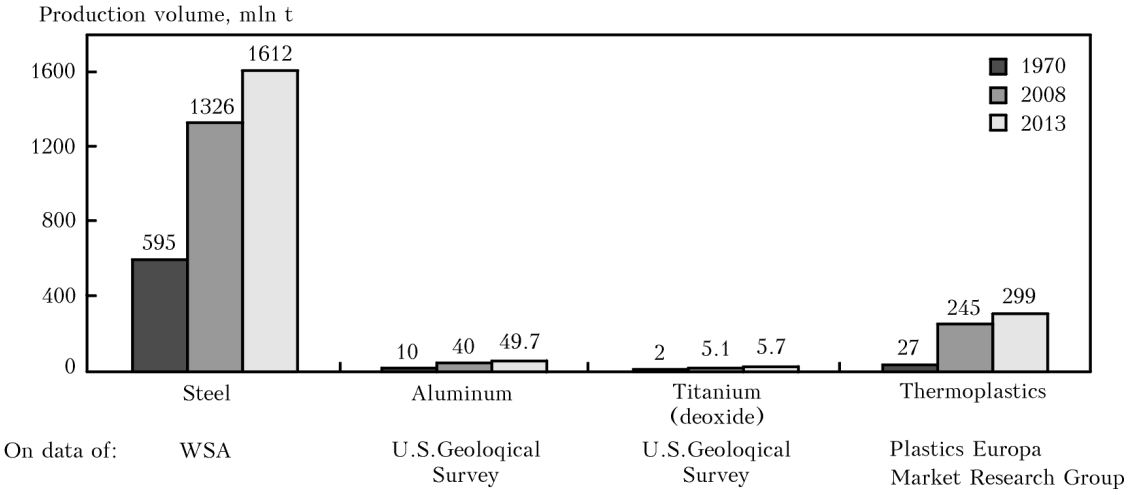

Figure 1. World production of the main structural materials in 1970, 2008 and 2013

of metallic titanium has risen approximately per 60 % in relation to the level of 2009. World production of titanium sponge in 2013 made around 222 thou t [5].

Regardless significant rise of consumption of non-ferrous, non-metallic and composite materials, steel is indisputable leader in the market of structural materials. Volume of steel production 4 times exceeds total volume of production of other structural materials [6].

According to World Steel Association (WSA) data, the world steel production increased per 1.2 % in 2014 in comparison with 2013, and achieved 1662 mln t. In 2014 the highest rise of steel production was observed in the Middle East. Rate of increase in this case made 7.7 %. The similar index for 2014 equaled 1.7 % in EU countries, it was 1.7 in the USA, 0.9 in China and 1.4 % in Asia.

Annual production of steel in Asia for 2014 made 1132.3 mln t and that in China was 822.7 mln t. Portion of the PRC in the world steel production reduced from 49.7 in 2013 to 49.5 % in 2014. Japan produced 110.7 mln t per year, South Korea 71 and India 83.2 mln t.

EU countries increased steel production per 1.7 % or up to 169.2 mln t in 2014. Steel production in Germany has risen per 0.7 % to 42.9 mln t in comparison with 2013, and in France made 16.1 mln t that is 2.9 % higher. In 2014 steel production in the USA made 8.3 mln t that is 1.7 % higher than the level of the last year [7].

Process of reduction of capacities of steel making production continues in the Western Europe, USA, Japan and its rise is observed in Asia (China, India) and the Middle East countries. Figure 2 provides the data characterizing change of regional distribution of the world structure of steel making capacities for 10 years in the period of 2005–2015.

Changes taken place in distribution of the steel making production capacities had an effect on the world regional structure of steel production (Figure 3). Based on OECD data a portion of North America and EU in the structure of steel production reduced from 10 and 16 % in 2007 and to 8 and 10 % in 2013, respectively, at that, portion of Asian countries rose from 56 in 2007 to 67 % in 2013.

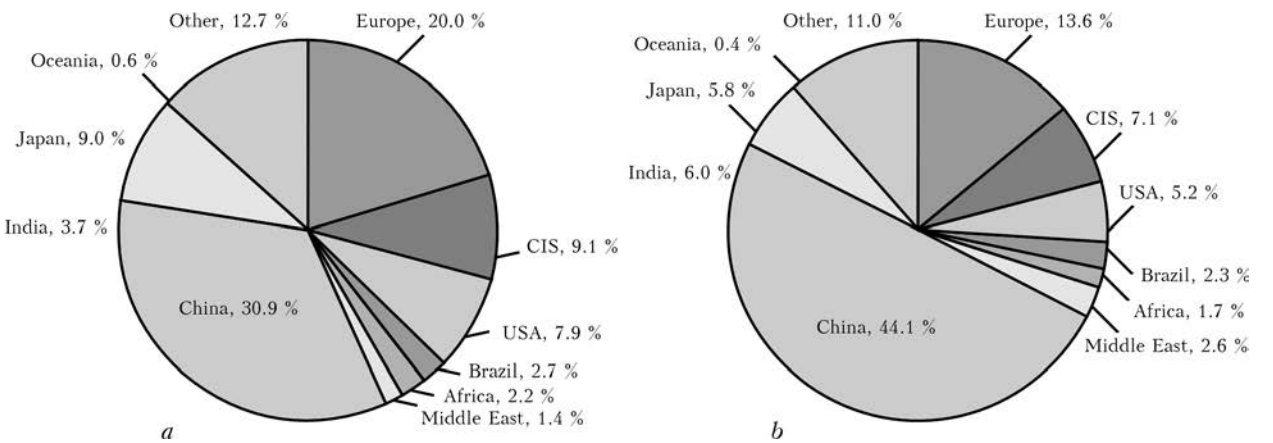

Figure 2. Regional distribution of production capacity of steel in 2005 (*a*) and forecast for 2015 (*b*)

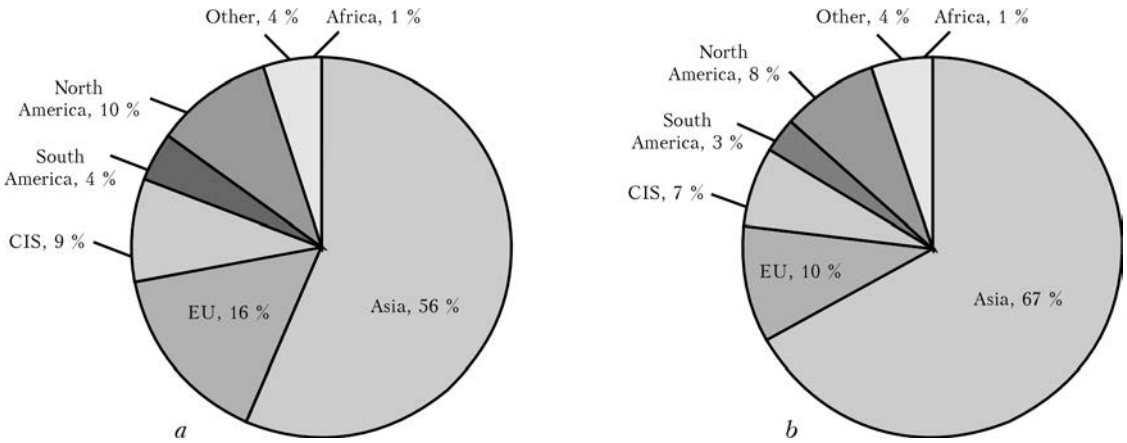

Figure 3. Regional distribution of world production of steel in 2007 (*a*) and 2013 (*b*)

World consumption of steel in 2013 exceeded 1.5 bln t. Estimation of the WSA specialist showed that the world consumption of steel in 2014 increased per 1.5–2.0 % up to 1.562 bln t, and in 2015 it will increase per 2 % more up to 1.594 bln t [7].

It is a well-known fact that more than 2/3 of steel products are reprocessed using joining technologies, mainly welding. Volume and structure of consumption of steel products on types of products, branches of industry, geographic areas determine the volume and structure of welding equipment market.

Data on the volume of consumption of steel and welding consumables in Japan, one of the world leaders on production and consumption of steel and welding consumables (Figure 4), can visually demonstrate effect of change of steel consumption on the sales volumes of welding consumables [4, 8].

The main consumers of steel in commercial production in 2011 were building (69 % of general consumption), machine-building (17 %), and transport including pipeline construction (19 %). It is predicted that the main consumers of steel in 2025 will be building (68 % of world consumption), machine-building (13 %) and pipeline construction (9 %). Their total portion are going to exceed 90 % of steel world consumption. Figure 5 provides for the data of steel consumption in the main branches of industry in 2011 and prediction for 2025 [6, 7].

Building branch makes significant input in the world and regional economics. Consumption of steel in the world building branch in 2011 made 845 mln t, i.e. 60 % of the total world steel consumption volume. It is expected that the volume of steel consumption in building by 2025 will make 64 % of the whole world volume and reach 1506 mln t. At that, portion of North America countries will make 18.3, EU 10.8, Japan 6.2 and China 24 % in the structure of world surplus value, developed in the branch. Annual growth of the surplus value, developed in building branch of China, will make 5.9 and that for India can be 8.1 % [6, 7].

World consumption of steel in power engineering makes around 31 mln t. This index will remain the same according to the estimation of Metal Bulletin Research in the period by 2025, but there are going to be shifts in the structure of steel consumption in separate sectors of the branch. Reduction from 17 to 16 mln t is expected in steel consumption of coal mining sector, at that portion of steel consumption decreases from 56 to 51 %. It is also forecasted 3 % decrease in steel consumption in hydropower engineering sector. In the period by 2025 the volume of steel

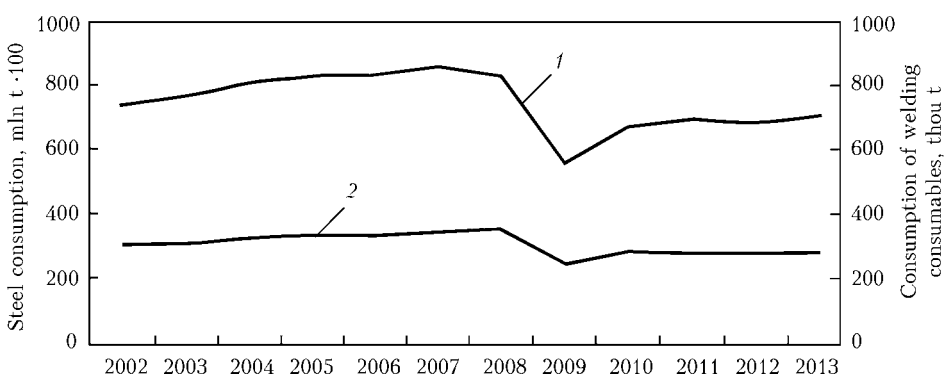

Figure 4. Change of steel consumption (*1*) and welding consumables (*2*) in Japan

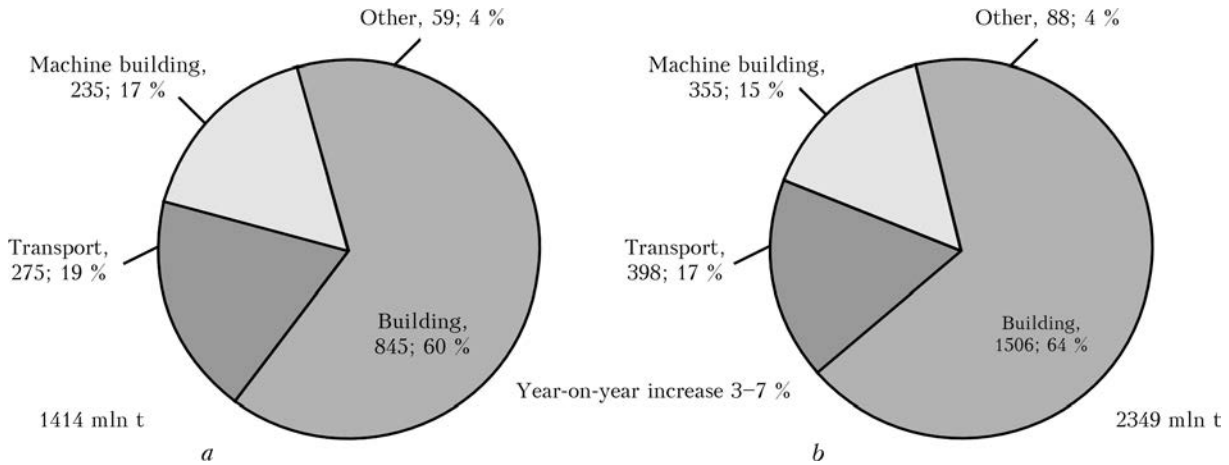

Figure 5. Branch structure of steel consumption in the world in 2011 (*a*) and forecast for 2025 (*b*) (here and in Figures 6 and 7 steel consumption in mln t and %, respectively)

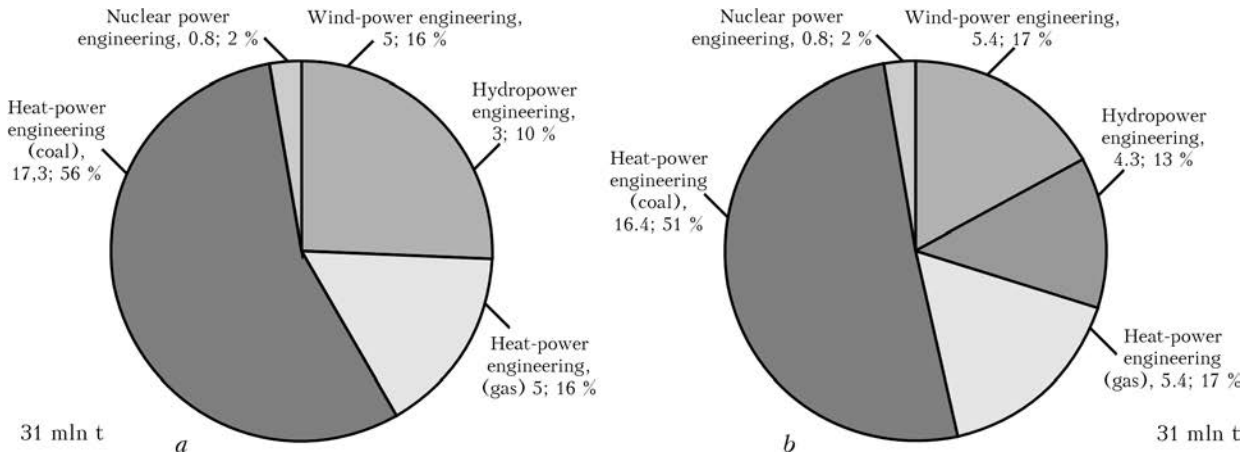

Figure 6. World consumption of steel in power engineering branches in 2011 (*a*) and forecast for 2025 (*b*)

consumption in this sector reaches 4 mln t. Figure 6 provides for the data of the steel world consumption in power engineering branches in 2011 and prediction for 2025 [6, 7].

Portion of transport machine building branch in 2011 made 19 % of the total world steel consumption, that was 275 mln t. Annual growth of steel in this branch is expected at the level of 2.7 % in the period by 2025. At that, the portion of steel consumption in transport machine building branch will reduce to 17 % and consumption volume will rise to 398 mln t. The main consumers of steel in the transport machine building are pipeline and motor car construction. Three forth of all steel consumption of the branch falls for their portion. Figure 7 shows the world structure

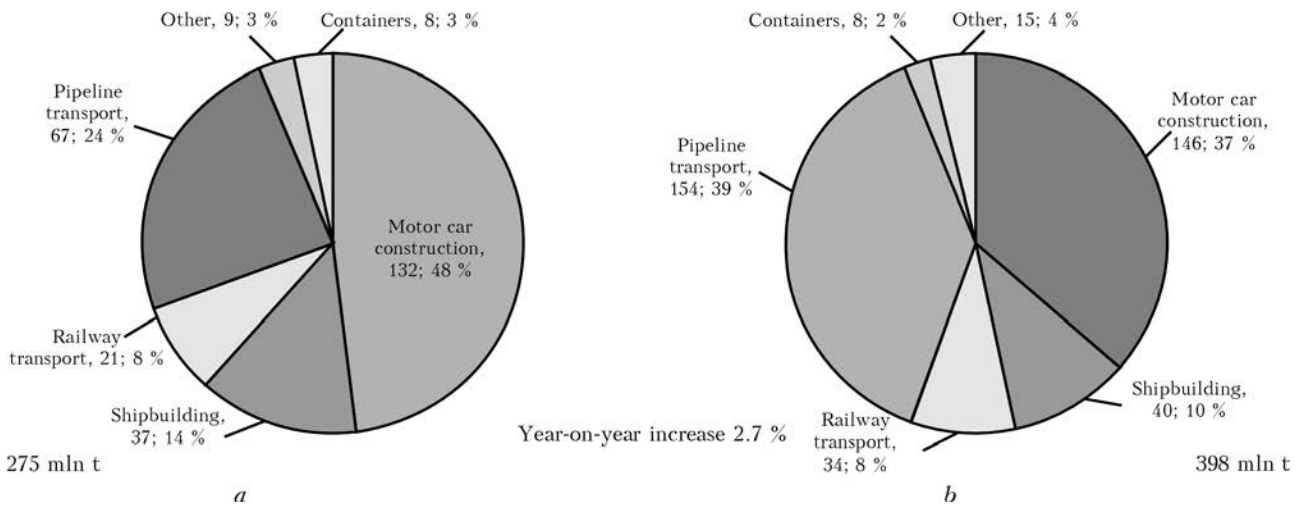

Figure 7. World consumption of steel in transport machine building branch in 2011 (*a*) and forecast for 2025 (*b*)

of steel consumption in transport machine building branch in 2011 and prediction for 2025 [6, 7].

Steel is a corner stone and drive of the world economy. In long-term prospects the volumes of steel consumption will grow, particularly in the countries with developing economies, where the rate of growth of metal-consuming branches of commercial production and population urbanization are significantly higher than in the advanced economy countries. This provides for substantial input in steel consumption. Growth of consumption of steel as one of the main structural material promotes for also expansion of application of the leading energy-saving and ecologically efficient technologies in commercial production and town development, which can not be fulfilled based on old worn equipment requiring replacement.

World market of welding equipment. World market of equipment for joining and material treatment, traditionally titled welding equipment market, shows continuous growth. This fact is noted in the annual and analytical reports of transnational companies, i.e. the world leaders of welding equipment production (Lincoln Electric, Colfax (ESAB, Victor Technologies Group), ITW etc.) as well as leading analytical companies, namely BCC Research, Transparency Market Research, Frost & Sullivan.

Welding equipment market is highly multifarious in its content. Its in kind and cost estimation depends on a range of services and goods, which are covered by that or another analysis. Most of the analytical companies incorporate welding consumables, equipment, gases for welding and cutting, means of individual protection and environment protection, welding accessories as a part of welding market goods. Company-manufacturers of welding equipment, making analysis of the volume of world welding market, first of all, evaluate it based on a range of output products. For example, ESAB company at market estimation incorporates means for automation, computerization and robotization in the range of welding equipment, and special welding consumables, namely for welding of special grades of steels and alloys, aluminum etc., are included as a separate position in the welding consumable range. Estimation of the markets of final consumers of welding equipment and regional markets also plays an important role in evaluation of the world market of welding equipment. Therefore, coverage of economical-statistical indices in estimation of the welding equipment market has significant effect on total estimation that explains indices spread in values during estimation of the volume of world market of welding equipment by different companies.

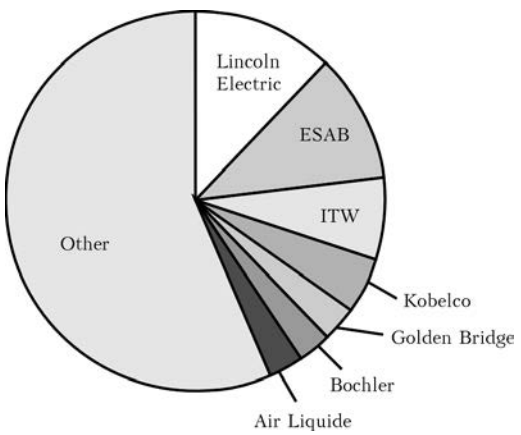

Figure 8. Main manufacturers in the world market of welding equipment in 2014

Below are the data of analysis of current state and prediction of development of the welding equipment world market published in analytical reports of the leading world company-manufacturers of welding equipment and analytical companies specialized in analysis of the welding equipment market.

Process of globalization of the welding equipment market takes place at present moment, namely capital concentration (merging of companies, acquisition of smaller good manufacturers by larger companies), migration of capital and labor at global level, standardization of technological processes etc. Capital and manufacturing capacities tend to migrate in Asia, South America and the Middle East countries. Seven transnational companies, among which undisputable leaders for decades are Lincoln Electric (14 % of market), ESAB (13 %) and ITW (8 %), control almost half of the world market of welding equipment. Total volume of sales in value of terms of these three companies exceeds 30 % of the world market of welding equipment (Figure 8).

Value of the market of welding equipment in 2013 made USD 17–24 bln according to estimation of the leading analytical companies. According to prediction of BCC Research, the volume of market in 2019 will exceed USD 25 bln and based on estimation of Transparency Market Research the welding equipment market will make around USD 24 bln in 2020. Annual growth of market at the level of 4.5–5.3 % [9, 10] is predicted in the period of 2014–2019 based on the data of the same companies.

Figure 9 provides for the data of estimation of the volume of world market of welding equipment by expert-analytical company BCC Research.

World market of welding equipment, by estimation of ESAB, made around USD 21 bln in 2012, 24 bln in 2013, and 25 bln in 2014. ESAB company when analyzing the world market of welding equipment proceeds from the estimation of filler materials markets, including for welding of medium alloy steels and alloys as well as welding of aluminum alloys; equipment and accesso-

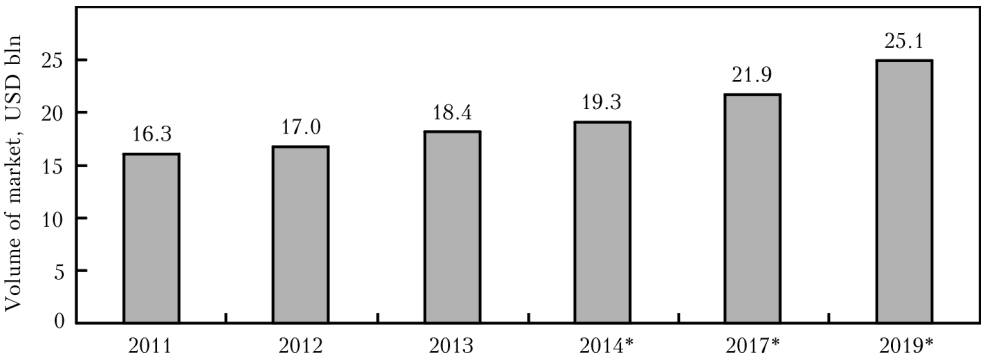

Figure 9. World market of welding equipment and consumables, including gases, means for protection of welder and environment, accessories and robots (* — estimation)

ries, including welding machines, equipment for manual plasma welding and cutting, apparatuses for gas welding and cutting and individual protection means; automated welding systems, robots and robotized complexes, machines for cutting, including automated tables and cutting systems [11].

Experts of Victor Technology Holdings, which is a part of global Colfax corporation as ESAB company, estimated the world market of equipment for welding and cutting approximately in USD 15.9 bln in 2013. At that they studied three main segments of products: goods for cutting including equipment for gas cutting, gas control regulators, plasma cutting and carbon arc gouging systems; equipment and accessories for arc welding; and materials for welding, surfacing and brazing.

According to estimation of the Victor Technology Holdings experts, the market of consumables for welding and surfacing made more than half of the world market in 2013. In the period of 2007–2013 portion of this market segment varied from 50 to 57 %. Portion of welding equipment market for the same period virtually did not change and made 24 %. In whole structure of the world market of welding equipment was sufficiently stable in 2007–2013, and no significant fluctuations in the structure of consumption of separate types of products were observed (Figure 10) [11].

Data of the Japan Welding News for the World showed that the volume of world consumption of welding consumables made 6.3 mln t in 2013. Consumption of coated electrodes (38) and solid wire (37 %) makes the main portion in the structure of world consumption of welding consumables. Table 1 provides for the data of world volume of consumption of main types of welding consumables in quantitative terms and portion of their consumption in the world in 2011 and 2013 [12, 13].

Tendency to reduction of consumption of coated electrodes and growth of solid and flux-cored wire consumption is observed from the Table in addition to rise of total volume of welding consumable consumption. This indicates increase of the level of mechanization and automation of processes of arc welding.

Analytical company BCC Research carried an analysis of the world market of welding equipment in terms of key technological segments, among which are arc welding, resistance welding, gas-oxygen welding, laser welding etc. Market analysis includes data on the volume of market of welding equipment and consumables, different gases for welding, means of individual protection and environment protection, welding robots and accessories. The volume of world market of welding equipment and consumables made USD 18.4 bln in 2013 according to the BCC Research data. Figure 11 shows the cost structure of the world market of welding equipment and materials in terms of technological segments of the market of welding equipment by BCC Research estimation [9].

Arc welding traditionally dominates in the welding equipment market. Its portion in the

Table 1. Structure of world consumption of main types of welding consumables in 2011 and 2013

Welding consumables	Consumption volume, portion			
	2011		2013	
	t	%	t	%
Coated electrodes	2,442,700	41.1	2,389,300	38.0
Wire for submerged arc welding	669,000	11.3	706,200	11.2
Solid wire	2,085,200	35.1	2,324,400	37.0
Flux-cored wire	748,700	12.6	863,700	13.8
Total	5,945,600	100	6,283,600	100

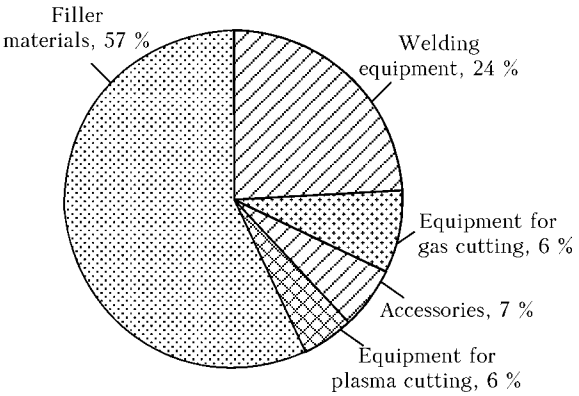

Figure 10. Structure of world market of welding equipment in the volume of main types of products in 2013

world market has reduced only for 3–5 % for the last 20 years, regardless the fact of significant expansion of application in commercial production of beam and other special processes for material joining. Estimation of experts of Lincoln Electric and Frost & Sullivan showed that the market of equipment for arc welding would make around USD 20 bln in 2014 at its 6 % annual growth [14, 15].

Market of equipment for different types of resistance welding reached USD 570 mln by Frost & Sullivan estimation. It is predicted that the market volume would make USD 640 mln in 2014 at 5.1 % annual growth, and will reach 820 mln in 2019 during the period of 2014–2019 [16].

World market of welding equipment continues to grow in cost as well as natural indices. The world market of equipment for arc and resistance welding showed annual increase per 14–15 % in the period of 2010–2013 according to The Japan Welding News for the World. Table 2 provides for the data of this market in natural units and their portion for 2011 and 2012 [17, 18].

In 2011 the world market of equipment for arc and resistance welding made 1178.61 and in 2012 it was 1355.55 thou units, from which around 96 % are the machines and apparatuses for arc welding. Growth of the sales in the market of welding equipment in the period of 2011–2012 made approximately 15 %. At the same time, it should be noted that the sales in the market of equipment for resistance welding increased per 20 %.

Regional structure of the welding equipment market underwent significant changes in the period of 2009–2014. The welding equipment market along with structural material market (steel, aluminum etc.) continued shift in the Asian region. Positive tendency was noted in the welding market of China, India, Taiwan and ASEAN countries. Portion of the Asian countries in the world market of welding equipment increased to 42 % in 2014, mainly due to China and India markets. 2 % increase of sales was also indicated in the markets of the Middle East (Iran), North America (Mexico) and South America (Brazil). American, European and Japan market of welding equipment somewhat reduced.

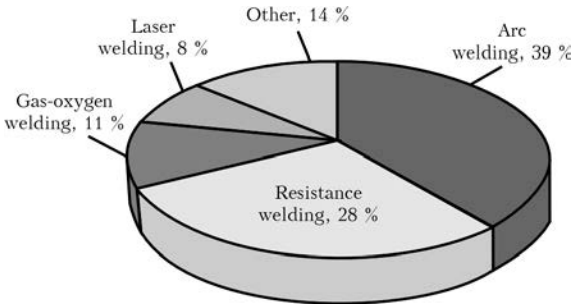

Figure 11. Welding technologies in world market of welding equipment in 2013 (cost structure)

At present time, the main regional segments of the welding equipment market are Asia — 42 % of market volume, America — 31, Europe, Russia, the Middle East and Africa — 27 %.

The main branch-consumers of welding equipment are building, transport, power engineering (including oil- and gas-production industry, electroenergetics, petrochemical industry, pipe production and pipeline construction etc.). Figure 12 represents industrial structure of the world market of welding equipment according to ESAB data [19].

Frost&Sullivan and Transparency Market Research estimations show current growth of consumption of welding equipment in a sector of industrial and civil engineering, freight transportation, motor car construction and power engineering, in particular, wind-power engineering. At that, such branches as power engineering, building and motor car construction are characterized as the main driving forces of the world market of welding equipment.

According to Frost & Sullivan data, the volume of market of welding equipment and consumables in 2011 made USD 445.5 mln for the

Table 2. World market of equipment for arc and resistance welding in 2011 and 2012

Welding equipment	Production volume, portion			
	2011		2012	
	thou units	%	thou units	%
For arc welding	1133.65	96.2	1301.70	96
For resistance welding	44.96	3.8	53.85	4
Total	1178.61	100	1355.55	100

world market of power engineering. It is predicted that in a period by 2017 the volume of welding equipment market in power engineering branch will reach USD 578.7 mln, at that its annual growth makes 3.8 %.

Insignificant growth of the welding equipment market in such branches as shipbuilding, airspace and military industries is the limiting factor for development of the world market of welding equipment.

Wind-power engineering is the most perspective segment of the welding equipment market by experts' estimation (ESAB, Frost & Sullivan). There is a continuous increase of investments in welding equipment on this segment of the market. According to estimation of ESAB specialists, each new megawatt of power requires 700 kg of welding consumables and 600 kg of welding flux. This segment of the market has good perspectives for further growth [19].

At present time, portion of the world production of energy using wind-driven power plants does not exceed 2 %. However, rates of power growth continuously increase, particularly in the countries with expanding economies from the Pacific region of Asia.

Frost&Sullivan experts also indicate in their researches an increase of the volume of sales of welding equipment in repair and reconstruction sector. Sales volume in this segment of the market of welding equipment and consumables exceeded USD 2.2 bln in 2010, and its annual growth is predicted to be on the level of 4 % in a period by 2017.

Analysis of the latter tendencies in the welding equipment market shows that future development of the welding equipment will be determine by necessity in:

• reduction of production costs and increase of productivity due to tendency to salary growth, increase of cost of materials for production of welding consumables and welding equipment as well as rise of expenses for power and fuel recourses will continue in future;

• improvement of welding structures and reduction of weight of deposited weld metal;

• increase of application in welded structures of the materials, particularly steels and alloys, with higher strength indices as well as light materials;

• increase of requirement to safety and quality of welded structures;

• increase of level of mechanization and automation of arc welding process;

• increase of application, where it is possible, of automated and robotized welding processes;

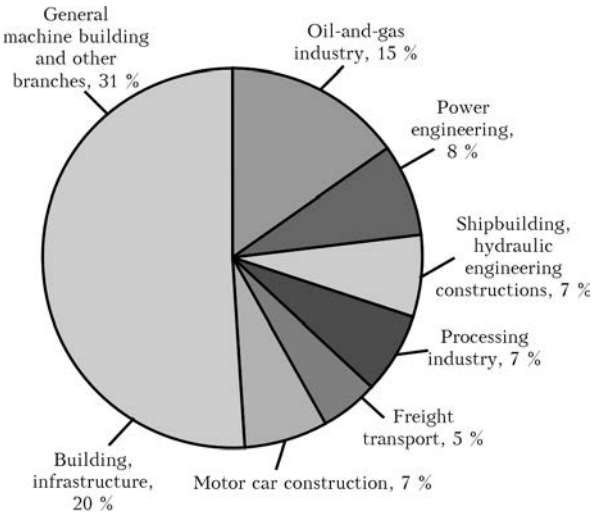

Figure 12. Welding equipment distribution by main branches of industry in 2014 in world market

• expansion of application of new welding methods using energy with high level of concentration (laser, electron beam), friction welding and other processes.

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