

**Regionalization and Globalization**

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**DEVELOPMENT OF CHEMICAL INDUSTRY
IN UKRAINE AND THE WORLD:
COMPARATIVE ESTIMATION****Abstract**

The main trends of the chemical industry development in globalization changes terms are investigated. The share of Ukraine in chemical products export of TOP-10 world chemical market participants and the European Union countries is determined. A comparative estimation of chemicals and pharmaceuticals production dynamics, as well as the structure of foreign trade (export / import) of these products in Ukraine and the EU-28 is conducted. The prospects for the domestic chemical industry development are outlined based on the calculation of Ukrainian and the EU members chemical enterprises main functioning indicators. The measures for innovation activity activation and the institutional reforms in Ukraine on purpose of the chemical production competitiveness increasing are proposed.

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Introduction

The chemical industry is one of the leading global industry segment. For example, in the US and the EU, chemical production accumulates the highest share of value added (16%) created in industry. In 2018, the share of chemicals production in the US reached 13.6% of the total industrial production in the country. In the EU, the chemical sector, which involved 12% of the employed in industry and mastered the largest volume of investment in industrial production (18%), accounted for 7.6% of sold industrial products (*EU chemical industry production, electronic resource*).

Producing intermediate consumption products (raw materials and semi-finished products) for all sectors of the economy, modern chemical industry determines largely the level of their competitiveness, as well as the development dynamics and the innovation processes direction. On the other hand, the wide assortment of household chemical products confirms its weight on the consumer market. The level of «chemigration» is a universally accepted criterion for the socio-economic development of any country. Thus, in industrialized countries, chemicals production shares from 5-8% to 13-16% in industry, while in Ukraine – less than 3%. Ukrainian chemical production is export oriented (the share of exports in the volume of sold chemical products in 2017 was 60%) and, at the same time, import-dependent (the share of imports in the intermediate consumption of chemicals and chemical products is > 95%), and, consequently, dynamics and results their functioning depends directly on the situation on the world market of chemical products.

Due to the key role of the chemical industry in balanced socio-economic development supporting, this sector become the subject of systematic researches. Thus, a scientists team of the Institute of Industrial Economics assessed the chemicals and chemical products manufacture main indicators, and

identified two strategic directions for the domestic chemical industry development in the neo-industrial concept implementation (*Amosha, Buleyev, Zaloznova, p. 302-305, 2017*). The problem of European chemical clusters functioning and the prospects for their creation in Ukraine is detailed in (*Shevtsova, Shvets, 2017*). The scientists of the Institute of Economics and Forecasting have thoroughly investigated the Agreement on the Free Trade Area provisions implementation and the its prospects for the chemicals production development in Ukraine, in particular in the direction of the export potential increasing and import substitution (*Heyets, Ostashko, p. 69-80, 2016*). The assessment of the basic chemistry and fertilizers market was carried out in (*Deyneko, p. 43-47, 2018*).

Currently, the chemical industry 4.0 (Chemicals 4.0) is actively forming in the world, which can be considered as a branch concept of the Fourth Industrial Revolution foundations implementation. This concept is intended to become a leading strategic benchmark for bringing chemical technologies, industries and markets to a fundamentally new level thanks to the systematic use of «smart» innovations and information and communication technologies. The content and features of the of the industry 4.0 concept in the chemical industry are covered in (*Shevtsova, 2017*). Ukraine also needs to develop and implement a new model for the development of the chemical industry, which would meet modern global neo-industrial changes and challenges within the industry 4.0. But the solution to this problem is rather problematic, primarily due to the high resource and energy intensity of the domestic chemical industry, caused by the low technological level of production, the critical state of fixed assets and the lack of innovative activity of enterprises and many other factors, both external and internal.

The purpose of the article is to determine the place of the chemical industry of Ukraine among the main participants of the world market of chemical products, in particular, the countries of the European Union.

Research results

The Ukrainian chemical industry is directly influenced by the consequences of the chemical products world market competitive environment transformation, which has intensified since 2015. Among the world chemical industry development key trends over the past 4 years, one can distinguish the following:

1. Mergers and acquisitions. In 2015, the merger of Dow and DuPont took place, and in 2016 it was purchased by the Chinese national company ChemChina of Syngenta Corporation (the world's largest producer of plant and seed and plant protection products), as well as the conclusion of an agreement between the German Concern Bayer and the American producer of genetically

modified seeds and herbicide Monsanto. These megazlites are caused by a number of factors, namely:

- falling prices for grain and slow growth of the agricultural segment of the world economy;
- the need to increase the resource base in the most promising agro-sectors;
- the desire to increase the efficiency of chemical production, in particular, by using opportunities to attract low-cost financing.

2. New regulatory environment formation. In particular, the Lauthenberg Act was passed, which sets out a single standard (plus the requirements of existing state and local regulations) regarding the safety of chemical production in the world.

3. Investment activation. First of all, it concerns North America, where a large wave of multibillion-dollar investments in new production facilities of chemical production took place.

4. The introduction of innovative technologies designed to reduce costs for producers, as well as create new business models that would help to establish relationships between chemical manufacturers with suppliers, their direct customers and end users. Thus, due to the automation and use of IIoT (Industrial Internet of Things), the operational and business environment in the chemical industry undergoes radical changes, in particular: the practice of embedding intelligent sensors in production capacities that control performance or transmit data to object managers is introduced to identify optimal operating conditions and the need for preventive maintenance; automation has been applied to improve the safety of workers of chemical plants, etc.

According to experts from the international corporation GeneralElectric, today the world chemical industry is undergoing more radical changes than at any given time in the last 40-50 years, and the pace of these changes continues to grow (*The industry is undergoing more disruptive change than perhaps at any point in the past 40 to 50 years, and the pace of this change continues to intensify, electronic resource*).

In 2017, world chemicals production grew by 3.5% compared with the previous year, in particular: in the EU-28 by 3.8% (vs. 0.4%), in the US – by 2.9% (vs. 1.0%), in Japan – by 7.2% (vs. 1.7%), in Asia – by 3.8% (vs. 5.8%) (*Trends in the chemical industry, electronic resource*). As a result, the EU-28 remained the world leader in the chemical industry, primarily due to the chemicals export, which grew by 6.2% in 2017 compared to the previous year, with a positive trade balance of EUR 138.35 billion (vs. 128.41 in addition to the EU-28, in 2017, the United States and China (authors' calculations) were among the top three exporters on the world market for chemical products in 2017.

The share of Ukraine in chemicals export to the top 10 participants in the world chemical market was the highest in 2011, however, since 2012 there is an annual decrease in the values of this indicator (Table 1).

Table 1

**The share of Ukraine in the export of chemical products
 of the top 10 participants in the world chemical market, %**

Країна	2010	2011	2012	2013	2014	2015	2016	2017
EU-28	1.08	1.47	1.36	1.15	0.84	0.63	0.45	0.40
USA	1.70	2.42	2.28	1.93	1.45	1.04	0.80	0.74
China	3.68	4.40	4.16	3.36	2.27	1.64	1.27	0.76
Japan	4.22	6.12	6.16	5.41	4.31	3.47	2.48	2.15
South Korea	6.53	8.22	7.67	6.07	4.50	3.63	2.63	2.18
Canada	9.71	12.79	12.78	10.68	8.08	5.84	4.58	4.40
Singapore	8.07	9.75	8.71	8.03	5.77	4.55	3.39	3.31
India	12.29	14.62	11.24	9.06	7.62	5.72	4.13	3.73
Mexico	27.44	35.99	31.18	26.28	19.86	15.13	11.80	12.01

Author's calculations by (State Statistics Service of Ukraine; UN Comtrade Database, electronic resource)

The share of Ukraine in compare to EU-28 chemicals export in 2017 was only 0.4% (compared to 1.47% in 2011). Ukrainian chemicals export in compare to the leading EU chemical producers is also minor, in particular: 1.7% of German chemicals export in 2016-2017 and less than 5% in France, Belgium, Ireland (Table 2). In addition, during this period, Ukraine exported substantially less chemical products than such post-socialist countries as Poland, Slovenia, Hungary and the Czech Republic.

The EU chemical industry leader is Germany, which produces 1/4 of world chemical products, and also takes 2nd place – in terms of its exports. The share of Germany in EU-28 chemicals export was 27% in 2017. The next countries were also included to the top 10 EU-28 by the share of chemicals export: France – 11.2%, Belgium – 10.5%, Ireland – 10.3%, United Kingdom – 8.6%, the Netherlands – 7.2%, Italy – 6.9 %, Spain – 4.6%, Denmark – 3.1%, Sweden – 2.5% (author's calculations by *State Statistics Service of Ukraine; Annual detailed enterprise statistics for industry, electronic resource*).

Table 2

Ukrainian chemicals export in compare to the EU countries, %

Country	2010	2011	2012	2013	2014	2015	2016	2017
Austria	45.4	61.0	59.2	48.9	35.9	29.5	20.2	21.7
Belgium	8.2	12.3	10.7	9.4	7.3	5.6	4.1	4.2
Bulgaria	334.1	427.5	412.0	347.0	246.4	201.6	172.3	157.6
United Kingdom	8.9	13.5	12.9	11.9	9.1	5.3	4.7	5.2
Greece	333.1	532.2	528.6	405.1	306.4	250.0	187.5	178.1
Denmark	44.1	60.5	49.4	38.1	28.4	20.1	13.7	14.3
Estonia	1157.8	1107.3	935.8	875.8	753.8	755.6	526.4	484.6
Ireland	10.6	14.1	15.8	13.0	9.2	5.9	4.1	4.3
Spain	24.0	33.0	30.7	23.5	17.1	13.3	9.9	9.7
Italy	16.3	22.1	21.3	16.9	13.4	10.5	7.2	6.4
Cyprus	1981.1	3103.6	2509.8	2053.7	1590.9	1165.1	850.4	834.5
Latvia	919.4	1187.5	1062.7	874.8	623.3	545.4	347.4	313.1
Lithuania	370.8	435.4	390.2	321.7	238.0	182.8	120.1	109.4
Lithuania	813.4	1088.6	1243.0	1078.8	865.8	683.2	497.1	464.5
Luxembourg	3907.5	5479.4	6758.8	5053.3	2972.0	1332.7	882.5	829.4
Malta	2677.4	4015.4	3846.0	2689.3	2041.4	1468.4	194.9	1617.0
Netherlands	16.7	19.3	17.8	15.2	11.6	8.8	6.8	6.2
Germany	4.3	5.9	5.4	4.3	3.2	2.4	1.7	1.7
Poland	80.1	108.5	94.3	74.1	59.5	49.7	34.0	30.7
Portugal	344.5	369.9	366.1	299.6	206.6	169.0	124.8	127.1
Romania	286.6	296.5	292.6	280.3	223.1	217.2	166.1	155.4
Slovenia	195.4	250.3	228.5	169.9	126.6	110.8	84.4	82.9
Hungary	125.4	173.0	149.5	111.8	97.2	80.4	60.4	51.3
Finland	126.6	164.6	164.7	143.2	116.6	75.4	59.7	57.9
France	8.6	11.9	11.3	9.3	7.2	5.5	4.1	4.0
Croatia	447.1	574.7	570.3	495.3	404.1	320.7	181.9	161.1
Czech Republic	174.6	235.3	219.7	186.2	145.0	122.0	93.5	91.9
Sweden	42.6	58.9	55.1	43.9	34.8	24.9	18.8	18.1

Author's calculations by (State Statistics Service of Ukraine; Annual detailed enterprise statistics for industry, electronic resource)

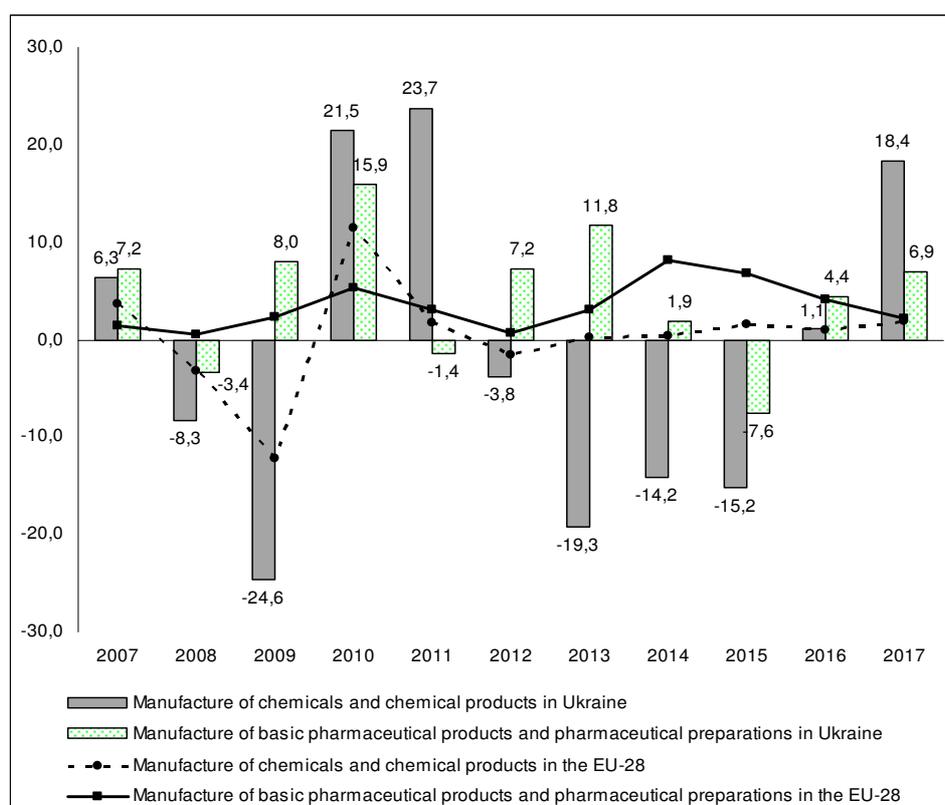
The largest volumes of chemical production (in value terms) in the EU-28 were achieved in 2015, which in turn caused an increase in exports with virtually the same level of chemicals import. In 2017, there was a slight increase in

chemicals production (by 1.5%, as compared to the previous year), as well as by a substantial increase (by 6.2%) in export.

By 2013, the trends of the chemical industry in Ukraine and in the EU-28 were the same: the decline in chemicals production in 2007-2009, growth in 2010 and the decline in 2012 (Fig. 1).

Fig. 1

The growth (decrease) of chemicals and pharmaceuticals manufacture in Ukraine and the EU-28, % to the previous year



Built by (State Statistics Service of Ukraine; Annual detailed enterprise statistics for industry, electronic resource)

During 2013-2015, the chemical industry development trends had been changed. So, when there was a slight increase in the chemicals production (from 0.2% in 2013 to 1.5% in 2015) in the EU-28, in Ukraine there was a significant decrease (from -19.3% in 2013 to -15.2% in 2015). Instead, in 2017, the chemicals production in Ukraine grew by 18.4%, while the production of basic pharmaceuticals and pharmaceuticals increased by 6.9%, whereas in the EU-28 the growth of these indicators was only 1.8% and 2.1% respectively. This has been evidence of a higher (compared with the EU chemical industry) domestic chemical industry vulnerability to the external and internal environment changes.

Against the backdrop of accelerating growth in the chemicals production in the EU-28 in 2017, the slowdown in the growth rate of high-tech basic pharmaceuticals and pharmaceuticals manufacturing began in 2015 and dropped to 2.1% (vs. 8.1% in 2014). However, despite the negative trends in production, pharmaceutical products are dominant in foreign trade compared to other chemical products. Thus, in 2017, this commodity sub-group accounted for 47% of exports and 39% of EU-28 chemical imports, while demonstrating the highest average annual growth rates of exports and imports for 2007-2017 – 8.8% and 8.7% respectively (Table 3).

The largest pharmaceutical manufacturers in Europe are Switzerland (25.9% of the total EU-28 pharmaceutical production in 2016), Germany (16.8%), France (13.4%), Italy (9.5%), Belgium (8.6%), Denmark (5.1%), Spain (4.7%). The highest rate of growth was in Greece (17.9%), Romania (15.2%), Norway (13.7%), Denmark (12.1%), the Czech Republic (10.6%), Switzerland (10.5%), while in Germany, France, Italy, Spain and Belgium, the value of this indicator was significantly lower (5.5%, 5.3%, 6.3%, 2.8%, and 3.4% respectively). High rates of foreign trade are also typical for organic chemicals, which occupied 13.3% of exports and 23.1% of EU chemicals import in 2017.

The volume of chemical products domestic exports in the EU-28 exceeds the volume of external exports, which means a greater orientation of producers to the domestic market of the EU than to foreign markets. The largest gap between the volumes of domestic and foreign exports is observed in such commodity subgroups as fertilizers (in 2017 the volume of domestic exports exceeded the volume of external exports by 2.3 in times) and plastics in primary forms (by 2.8 in times) (Fig. 2). At the same time, the volume of domestic exports of the largest commodity subgroup – organic chemistry – was only 9% higher than the volume of external exports, indicating the manufactures orientation to the same extent both on the domestic EU market and on the external market.

The structure of chemical products foreign trade in Ukraine differs from the similar EU-28 structure. So, when in the EU the priority is export of pharmaceuticals (46.95% in 2017) and organic chemical compounds (13.31%), in Ukraine the main part of exports is taken by products of inorganic chemistry (47.0%). Fertilizers, which are the second largest pharmaceutical importer in Ukraine (17.2% in 2017), in the similar structure of EU-28 imports, occupy the smallest share

(2.2%) among all product subgroups. At the same time, the commodity structure of chemical products export in Ukraine is being transformed in the direction of approaching to structure of the EU-28: it increases the pharmaceuticals and organic chemicals export share. The common feature of chemical products import structure in Ukraine and the EU-28 is the dominance of pharmaceuticals share, which value in 2017 accounted for 27.0% and 39.4%, respectively.

Table 3

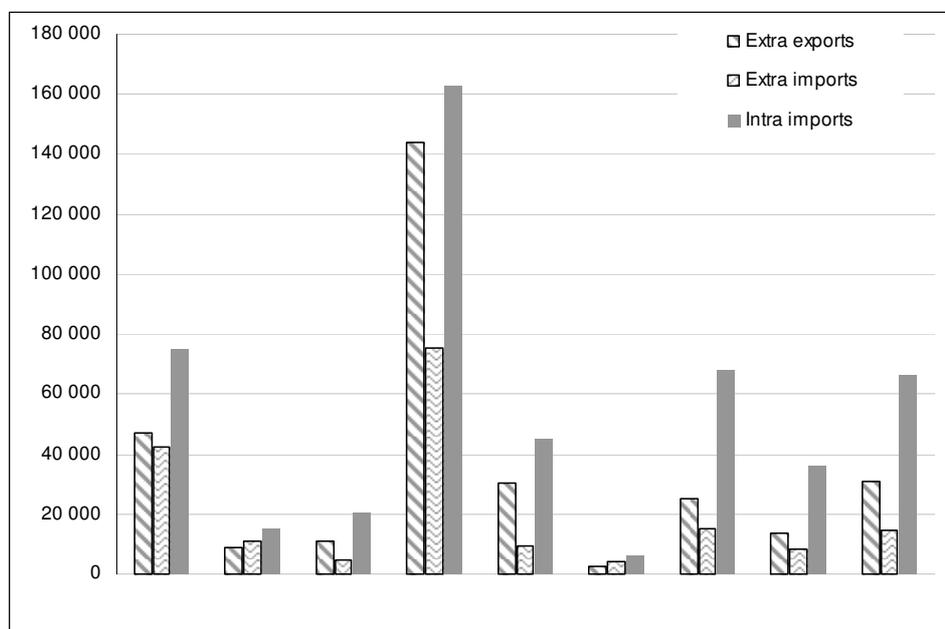
**Commodity structure of foreign trade in chemical products
 in Ukraine and EU-28**

Commodity subgroup	EU				Ukraine			
	2014	2015	2016	2017	2014	2015	2016	2017
% in the structure of export of chemical products								
Organic chemicals	15.59	15.63	15.09	13.31	5.05	3.12	4.40	8.50
Inorganic chemicals	3.17	3.01	2.78	2.87	38.58	45.40	40.50	47.00
Pharmaceutical products	42.43	45.26	45.92	46.95	8.37	7.29	11.82	11.57
Essential oils, resinoids and perfume materials	9.76	9.34	9.66	9.71	5.73	5.00	5.99	6.58
Fertilizers	0.97	1.01	0.85	0.86	22.74	25.06	21.06	7.78
% in the structure of import of chemical products								
Organic chemical compounds	24.24	24.31	22.82	23.12	10.46	11.36	9.69	9.32
Inorganic Chemistry Products	7.78	7.08	5.96	5.94	4.51	5.67	5.44	5.79
Pharmaceutical products	38.06	38.98	40.74	39.40	36.47	27.29	28.60	27.00
Essential oils, resinoids and perfume materials	4.53	4.78	5.11	5.11	10.46	9.81	9.29	9.16
Fertilizers	2.53	2.52	2.15	2.20	8.74	14.14	14.64	17.21

Author's calculations by (State Statistics Service of Ukraine; Annual detailed enterprise statistics for industry, electronic resource)

Fig. 2

Foreign chemical products trade in EU-28 in 2017, EUR million



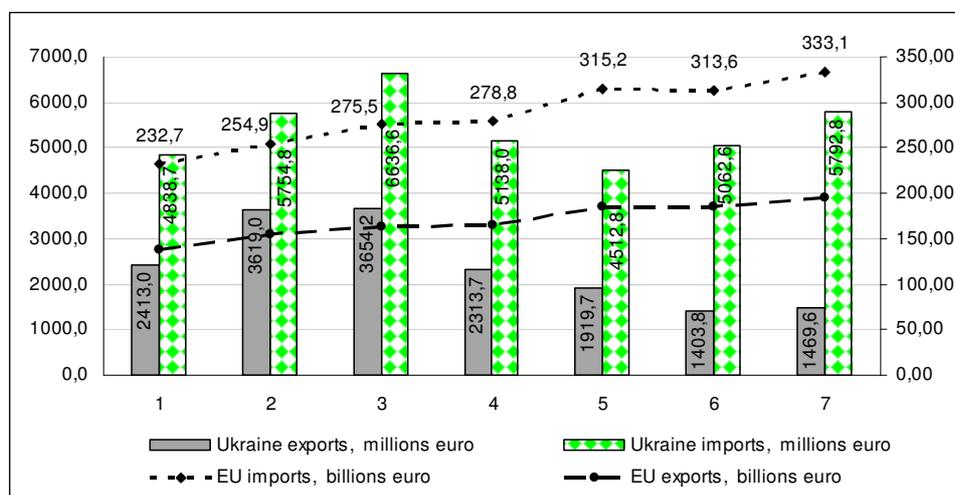
- 51- Organic chemicals
- 52- Inorganic chemicals
- 53- Dyeing, tanning&colouring materials
- 54- Medical and pharmaceutical products
- 55- Essential oils, resinoids and perfume materials
- 56- Fertilizers (other than those of group 272)
- 57- Plastics in primary forms
- 58- Plastics in non-primary forms
- 59- Chemical materials and products

Built by (Annual detailed enterprise statistics for industry, electronic resource)

For the indicators of the chemical products foreign trade dynamics EU-28 is characterized by higher stability, compared with Ukraine. Thus, in particular, if the EU-28 is undergoing an annual increase in the volume of chemicals export, the tendency for export growth was observed in Ukraine until 2012 and recovered only in 2016-2017 years (Fig. 3). As a result, the volume of chemical products Ukrainian exports of in 2017 amounted to only 40.2% of its volume in 2012, while the EU-28 exports increased by 20.9% over this period.

Fig. 3

Dynamics of chemical products export and import in Ukraine and EU-28



Built by (State Statistics Service of Ukraine; Annual detailed enterprise statistics for industry, electronic resource)

According to the results of author's calculations carried out on the basis of the data of the State Statistics Service of Ukraine (*State Statistics Service of Ukraine, electronic resource*) and Eurostat (*Annual detailed enterprise statistics for industry, electronic resource*), the chemicals import trends in the EU countries (which are characterized by stable insignificant growth), correlate with the trends of export performance. While in Ukraine, after a tangible decrease in chemical products import (by 32% during 2014-2015), since 2016, its intensive growth is taking place.

Low values of performance indicators are typical for Ukrainian chemical industry (in particular, in the production of chemicals) (Table 4). Thus, according to the number of chemical enterprises, Ukraine is second only to the UK, Spain, Italy, Germany, France and Poland, which are the leaders of the chemical industry development in the EU. Instead, the volume of chemical products sales per one chemical enterprise in Ukraine (0.97 million EUR in 2016) is significantly lower than in the EU countries. Thus, in particular, this indicator in Belgium was higher than in Ukraine, almost in 62 times, and in Poland – in 6.3 in times.

Table 4

**Indicators of the functioning of the chemical industry
(production of chemicals and chemical products)
in Ukraine and the EU countries in 2016**

Country	Number of chemical enterprises	ORCP, million euros	OPCP per chemical enterprise, ths. Euros	OPCP per employee, thousand euros	Share of chemical products in volume of industrial products sold, %	Share of employees in the product and chemical products, %
Ukraine	2046	1987.7	971.5	28.4	2.6	2.9
Austria	360	13377.2	37158.9	742.7	7.4	2.9
Belgium	562	33732.6	60022.4	784.3	13.7	8.7
Bulgaria	606	1455.4	2401.7	102.0	4.9	2.6
UK	2826	36386.9	12875.8	411.7	5.2	3.4
Greece	979	2150.6	2196.7	207.3	4.6	3.3
Denmark	263	5362.0	20387.8	459.7	4.8	3.8
Estonia	110	452.4	4112.7	191.7	3.8	2.2
Spain	3409	37132.2	10892.4	422.9	8.0	4.7
Italy	4312	49570.7	11496.0	459.1	5.6	2.9
Cyprus	57	86.4	1515.8	138.5	2.8	2.1
Latvia	231	218.3	945.0	76.7	2.8	2.4
Lithuania	144	1774.8	12325.0	334.8	9.8	2.5
Luxembourg	16	332.4	20775.0	296.8	2.5	3.3
Malta	40	32.8	820.0	114.8	1.3	1.3
Netherlands	893	43760.7	49004.1	989.5	13.6	6.4
Germany	3121	160450.4	51409.9	472.1	7.7	4.6
Norway	222	5585.2	25158.6	541.1	6.7	4.6
Poland	2444	14960.5	6121.3	184.6	5.2	3.1
Portugal	791	4319.4	5460.7	345.4	5.3	1.8
Romania	851	2283.7	2683.5	101.6	3.0	1.9
Slovakia	446	1657.1	3715.5	186.5	2.3	1.9
Slovenia	206	1270.5	6167.5	198.0	4.8	3.3
Hungary	663	5638.5	8504.5	373.1	5.5	2.0
Finland	288	7686.3	26688.5	601.9	6.3	3.8
France	3042	66628.6	21902.9	457.8	7.3	5.0
Croatia	358	730.1	2039.4	124.4	3.6	2.2
Czech Republic	1815	6142.6	3384.4	202.4	3.8	2.3
Sweden	821	9438.9	11496.8	448.8	4.8	3.5

Author's calculations by (State Statistics Service of Ukraine; Annual detailed enterprise statistics for industry, electronic resource)

The ORLh per worker in Ukraine is in 2.7 times lower than in Latvia (the lowest value of this indicator among EU countries) and almost in 35 times – than in the Netherlands. By the share of chemical products in the volume of industrial products sold in 2016, Ukraine predominated only Luxembourg, Malta and Slovakia, and by the indicator of the share of workers engaged in the chemicals production – Bulgaria, Estonia, Malta and Slovakia.

Ukrainian chemical industry remains raw-oriented, determines the territorial concentration of basic chemical production, and, at the same time, determines the need for structural transformation of this sector in the direction of high-tech industries increasing. However, such a transformation should foresee the need to preserve existing competitive advantages (raw material deposits and production capacities) that can be used to develop the chemical industry in the long term. Therefore, the priority for development in Ukraine should be those chemicals which are considered as raw materials and semi-finished products not only for the chemical but also for other sectors (light, food, etc.) industry, as well as other types of economic activity.

Conclusions

Summing up the results of the conducted research, low efficiency of Ukrainian chemical industry functioning, in particular, compared with the EU countries can be noted. Thus, the volumes of domestic chemical products production and export are in ten times smaller than in the EU-leading chemical manufacturing countries, and the turnover per one chemical company in Ukraine is significantly lower than in European countries. In addition, the dynamics of chemical production in the EU are characterized by much more stable tendencies, while the chemical industry of Ukraine, being export-oriented and, at the same time, import-dependent, directly depends on the state of the chemical products world market. On the other hand, the fact of active chemical production growth in Ukraine in 2016-2018, which in several times exceeded the figures in EU countries, gives grounds for the statement about the domestic chemical industry prospects.

In the context of the global chemical industry new architecture formation, a key guideline for the chemical companies development is the innovation, which confirms the need to intensify innovation activities in Ukraine. The main motivation to innovate is the demands of the market, that is, consumers of chemical products (sectors of the economy and the population) and pressure against competitors. The realization of such a task, for its part, requires:

- high-tech chemical production development stimulation through selective subsidization (increase of target state subsidies) on the example

of the EU member states, preferential crediting and taxation, with increasing the knowledge of the products, giving preferences (additional points) in conducting tenders for the receipt of a state order, provided the values of the coefficient localization of internal potential at a certain level, involvement in the implementation of state target programs, etc .;

- creation of effective technological chemical industry development forecasting system (primarily with the participation of the institutes of the National Academy of Sciences of Ukraine) on the basis of constant monitoring of the technical re-equipment level.

In order to increase the competitiveness of the chemical industry in Ukraine, institutional reforms are called for, in particular, to promote:

- formation of vertically and horizontally integrated institutional structures for the production of chemical products with a full technological cycle (from raw materials to final products);
- creation of clusters, industrial (chemical) parks and other associations of industrial, scientific and commercial enterprises of various types of economic activity for the implementation of priority investment and innovation projects;
- stimulating the chemical enterprises participation in the formation of stable cooperative ties, ensuring inter-sectoral and interregional cooperation.

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