Assessment of Cement Market Conditions and Forecast of Cement Industry Development in Kazakhstan in The Context of Sustainable Development

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Abstract. This article discusses the current state of the cement market in Kazakhstan at the present stage. Construction in Kazakhstan is one of the parameters for the development of the country's economy. The rapid development of construction companies made it possible to concentrate the location of cement production in those regions where the main cement production enterprises are concentrated. Assessing the global development of the cement industry, it can be noted that the main consumer is the People's Republic of China, but by 2050 significant development is expected in India and African countries. Considering the existing production volumes of cement in Kazakhstan, the total volume reached 12 million tons. Based on the development trends of GDP, construction works, cement production, a linear model was developed, with the help of which a forecast was made for the development of cement production for the period 2023-2025 in Kazakhstan. Given that the cement industry is a dirty industry, suggestions are made for the latest technologies and existing innovations. Proposals include reducing emissions by using new types of cement that require less heat to produce, and using carbon capture and storage technology. Also, with the continuous growth of population and urbanization, there will be the use of cement-based substances in various fields such as civil engineering, medicine, etc. using new types of cement that require less heat to produce, and using carbon capture and storage technology. Also, with the continuous growth of population and urbanization, there will be the use of cement-based substances in various fields such as civil engineering, medicine, etc.

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1. JEL classification: O18, P25, P48, N90

1. Introduction

Cement is a resource that plays a strategic role in the economy and its modernization. This is the main building material for any type of construction (primarily high-rise and industrial). At the same time, the cement industry has a number of functioning features: high energy intensity, increased requirements for environmental friendliness of production, regional localization of production in connection with the link to the raw material base and consumer markets due to the high share of transportation costs in the final price of the product. The cement industry all over the world is a branch of large business due to the high capital intensity of the organization of new industries [1].

The topic of this study is predetermined by the fact that the issues of cement production in the world and in Kazakhstan are related to the construction industry, being fundamental and relevant at all times, since the population needs housing, civil facilities and commercial buildings.

Given the need for housing construction and construction work around the world, they are now resorting to reducing the harmful emissions that are present in the production of cement. Simultaneously with the increase in the growth of cement production, there is a further and rapid commissioning of new structures, residential buildings, non-commercial buildings, which greatly affects the ecology of the regions where cement production is located.

2. Materials and methods of research

Capacity Assessment Issues construction industry cement market the economy of Kazakhstan is reflected in various scientific projects and studies. But, at the moment, certain methods and approaches have already been formed in the national economy in the analysis and evaluation activities of the cement industry sub-sector. However, so far none of them is universal for studying these processes, especially in the conditions of sustainable development of our country.

Therefore, it is possible to use various research methods as a methodological basis: dialectical, system-functional, economic-statistical, predictive-analytical, economic-mathematical and modeling, formal-logical methods, etc.

As a descriptive technique (analysis of theoretical concepts, review of sources, international experience, research methodology, description of information flows, etc.), the results of the current state of the cement market in Kazakhstan were obtained.

Using the economic-mathematical method, based on analytical data, a forecast was made for the further development of the cement industry in Kazakhstan.

The identified problems in the modern cement industry in our country helped to formulate a number of recommendations for the further effective development of the cement industry in Kazakhstan.
3. Literature review

At present, the issues of the cement market of Kazakhstan and the development of the cement industry for the modern period are not sufficiently covered in the scientific works of domestic researchers, to be more precise, there are practically few such studies [1].

The studies of Abeer M. El-Sayed, Abeer A. Faheim, Aida A. Salman and Hosam M. Saleh elucidated the features development of the cement industry in modern conditions [2].

In the works of such foreign researchers as Daniel M. Petroche, Angel D. Ramirez, a promising study on the issue of environmental profile of cement and concrete production based on Ecuadorian data [3].

The article provides an analysis of the scientific and practical views of foreign researchers on this issue. So, so we can agree with the opinions of I. Riley, M. Burbidge, R. Wang for questions development of the cement industry [4].

The development of the cement industry in Kazakhstan was directly or indirectly addressed in the works of the following scientists and practitioners, such as: G. Skripnik, N. Kachalova and others [8, 13].

In our opinion, the main theses in the works K. Levin, E. Stier. K. Levin, E. Stier about the impact innovations in the industry to combat climate change [11].

In this article, the authors summarized new material on the current state of the cement market in Kazakhstan and made a forecast for the development of the cement industry. But at the same time, the presented problem has been little studied and requires further scientific research.

4. Discussion

The cement industry is a capital-intensive, energy-intensive and critical industry for nationwide infrastructure construction. The international cement industry, although representing a limited share of world production, has grown at a faster pace than local demand in recent years [2].

Construction is the main consumer of cement. Construction is one of the main sectors of the economy, making a significant contribution to the increase in the gross domestic product of different countries. The construction industry is a dynamic sector of economic growth due to increased investment in infrastructure, construction, energy and transport [3].

With this in mind, China is the world's largest consumer. Therefore, it is expected that cement consumption in the country will remain in the range of 2.0-2.3 billion tons per year for 3-5 years, and only in the long term will decrease to about half of this level. We predict that by 2030 China's share in global cement consumption will decrease to 35% (Figure 1). This decline will be offset by growth elsewhere, mainly in India and Africa, where consumption is projected to almost double by 2030.

In 2020, global production of Portland cement reached 4.1 billion tons and is rapidly increasing year by year due to developing countries. China alone produced 2.37 billion tons in 2018, accounting for 57.6% of the global volume. High indicators and rapid growth rates in production are demonstrated by Turkey, Vietnam, and Indonesia, which are likely to surpass the USA in the next 5 years [4].
At the same time, the situation in Kazakhstan in the cement industry has an increasing trend, which for ten years, starting from 2013, amounted to 7.07 million tons and by 2022 reached 12 million tons.

According to the Statistics Committee of the Ministry of National Economy of the Republic of Kazakhstan, cement production for 12 months of 2022 amounted to 12.1 million tons. This is significantly more than forbes.kz predicted, but for the first time in many years, less than a year earlier. The result of 2022 lags behind the same last year by 4.4%; higher than the result of 2020 by 11.8%; and 2019 by 21.8%. [6]

**Table 1.** Volume of cement production, construction works and GDP in Kazakhstan

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Cement production</td>
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<td>7.98</td>
<td>8.59</td>
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<td>9.43</td>
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<td>10.81</td>
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<tr>
<td>The volume of construction work, trillion tenge</td>
<td>2.439</td>
<td>2.70</td>
<td>2.90</td>
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<td>3.50</td>
<td>3.80</td>
<td>4.42</td>
<td>4.92</td>
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<td>6.26</td>
</tr>
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<td>GDP (trillion tenge)</td>
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<td>54.38</td>
<td>61.82</td>
<td>69.53</td>
<td>70.71</td>
<td>83.95</td>
<td>102.89</td>
</tr>
</tbody>
</table>

Source [8]

Based on the indicated indicators in table 1, considering the correlation-regression analysis, we obtain an equation for estimating the volume of cement production in formula 1:

\[ y = 4.285194 + 2.093385x_1 - 0.04691x_2 \]

(1)

where

- \( x_1 \) - Volume of construction works;
- \( x_2 \) - Gross Domestic Product (GDP).

This equation makes it possible to estimate the future volumes of cement production based on existing trends and trends in the development of GDP and the volume of construction work. Modeling the future volumes of cement production, relying on the current pace of development, we will get 13.9 million tons by 2025 with the current trend (table 2). At the same time, these figures may change as a result of the fact that cement enterprises in Kazakhstan have a certain reserve, since the design capacity is maximum. At the same time, the ratio of the volume of construction work to GDP varies on average around 6.6%, and according to the forecast in 2025 in the amount of 6.75%, and in 2023 5.99%.

**Table 2.** Forecast of cement production, construction works and GDP in Kazakhstan

<table>
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Thus, in Kazakhstan there are cement production facilities with a design capacity of 2 million tons, such as Kokshe-Cement LLP, Central Asia Cement JSC, Standard Cement LLP (table 3). There are 15 enterprises in 11 regions where cement is produced. At the same time, the industry is represented by enterprises with a total design capacity of 16.5 million tons per year and an established production of more than 20 types of cement. [7]

**Fig. 1** World cement consumption (top 10 countries and African countries). Source [5]

**Fig. 2.** Production of cement in the Republic of Kazakhstan, thousand tons. Source [5]
The industry is represented by enterprises with a total design capacity of 16.5 million tons per year and an established production of more than 20 types of cement. [7] Table 1 shows cement production volumes, construction volumes and GDP. The information allows us to consider the development of construction and GDP in Kazakhstan over 10 years. All indicators have an annually growing trend, which is clearly reflected in the structure of GDP. Considering the indicators in Table 1, one can see the dependence of cement production, construction work and GDP. In this case, the multiple R was 0.962681, and the R-squared coefficient was 0.926754.

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main suppliers are the East Kazakhstan region (EKR), Shymkent and Zhambyl region. The placement of cement industry enterprises is primarily influenced by two factors: consumer-oriented and raw material-oriented. The first factor is expressed in the concentration of production near major consumers: significant industrial centers, major cities, in other words, places where active construction is taking place. The second factor is related to the location of cement raw materials. In some cases, waste from other industries is used as raw material for the cement industry [9].

**Table 3. Kazakhstan cement producers**

<table>
<thead>
<tr>
<th>No.</th>
<th>Company name</th>
<th>Region</th>
<th>Project capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>LLP «Kokshe-Cement»</td>
<td>Akmola</td>
<td>2 million tons</td>
</tr>
<tr>
<td>2</td>
<td>AlaCem LLP</td>
<td>Almaty</td>
<td>1.15 million tons</td>
</tr>
<tr>
<td>3</td>
<td>Central Asia Cement JSC</td>
<td>Karaganda</td>
<td>2 million tons</td>
</tr>
<tr>
<td>4</td>
<td>Bukhtarma Cement Company LLP</td>
<td>EKR</td>
<td>1.3 million tons</td>
</tr>
<tr>
<td>5</td>
<td>LLP «PK Cement Plant Semey»</td>
<td>EKR</td>
<td>1.2 million tons</td>
</tr>
<tr>
<td>6</td>
<td>Kazakhcement LLP*</td>
<td>EKR</td>
<td>1 million tons</td>
</tr>
<tr>
<td>7</td>
<td>LLP &quot;Zharma cement plant&quot;</td>
<td>Abai</td>
<td>1.2 million tons</td>
</tr>
<tr>
<td>8</td>
<td>LLP &quot;Standard Cement&quot;</td>
<td>Shymkent</td>
<td>2 million tons</td>
</tr>
<tr>
<td>9</td>
<td>Shymkentcement LLP</td>
<td>Shymkent</td>
<td>1.2 million tons</td>
</tr>
<tr>
<td>10</td>
<td>Gezhuba Shieli Cement Company LLP</td>
<td>Kyzylorda</td>
<td>1.0 million tons</td>
</tr>
<tr>
<td>11</td>
<td>LLP &quot;Rudny cement plant&quot;</td>
<td>Kostanay</td>
<td>0.5 million tons</td>
</tr>
<tr>
<td>12</td>
<td>CaspianCement LLP</td>
<td>Mangistau</td>
<td>1.0 million tons</td>
</tr>
<tr>
<td>13</td>
<td>LLP «Zhambyl cement production company»</td>
<td>Zhambyl</td>
<td>1.5 million tons</td>
</tr>
<tr>
<td>14</td>
<td>*ACIG JSC</td>
<td>Zhambyl</td>
<td>0.5 million tons</td>
</tr>
<tr>
<td>15</td>
<td>SAS-Tobe Technologies LLP</td>
<td>Turkestan</td>
<td>0.5 million tons</td>
</tr>
</tbody>
</table>

*temporarily suspended

On April 26, 2023, within the framework of the International Economic and Investment Forum in the Kordai district of the Zhambyl region, a capsule was laid in the foundation of the future cement production plant of KORCEM LLP, with a design capacity of 1.2 million tons [10]. The technical capacity of the cement industry in Kazakhstan, according to the Ministry of Investment and Development of the Republic of Kazakhstan, is about 17 million tons, and in the next 1-2 years it may increase to 19 million tons due to cement plants under construction. The average load of 15 existing enterprises in the industry today is 60–70%, that is, domestic production has a “margin of safety”. But representatives of cement plants fear that from 2022 the growth of domestic production may slow down due to the gradual reduction of free carbon quotas in the country [11].

Cement plants are one of the most impressive areas, releasing 15% of the world's pollution among various industries into the environment. These pollutants adversely affect human well-being, flora and fauna. Meanwhile, the use of cement-based substances in various fields, such as civil engineering, medicine, etc., is inevitable due to the continuous growth of population and urbanization [12].

The decarbonization of cement production, one of the most energy-intensive materials in the world, is another example of the need to attract innovation. Demand for cement is growing much faster than new solutions are emerging through innovation. To meet the 1.5°C global warming target, the energy intensity of the cement industry must be reduced by 40 percent...
over the next decade. Emission reduction strategies, such as the use of new types of cement that require less heat energy to produce, and the use of carbon capture and storage technology, have not yet been fully developed [13].

The use of alternative fuels can significantly reduce overall emissions compared to fossil fuel emissions, but climate benefits require careful analysis to track such reductions. According to the International Energy Agency, 60% to 80% of the carbon in municipal solid waste is biogenic; Here, the biogenic fraction of 0.7 is accepted. Replacing fossil fuels with alternative fuels derived from waste is an economical way to reduce the use of fossil fuels, and is also a relatively environmentally friendly method of waste management, especially if steps are taken to divert all recyclable materials before use in the furnace [14].

Cement production directly impacts the environment. Cement production accounts for 5% of global carbon dioxide emissions. The cement industry inevitably leads to CO2 emissions, with 60% of emissions resulting from raw material transformation at high temperatures, and 40% stemming from fuel combustion during material heating to the required temperature [15]. As of 2022, the cement sector has been allocated 7.2 million tons of CO2 emissions. This will allow the production of 9 million tons of cement within the quotas, while domestic consumption in Kazakhstan amounts to 11.5 million tons. Importing countries, primarily Uzbekistan with its expanded cement production capacity, and Russia, where carbon regulation is absent, will fill this gap. As a result, Kazakhstani plants will start to close," forecasts Akymbayev, the Executive Director of the Kazakh Association of Cement and Concrete Producers [15].

According to industry participants, leveling the market conditions can be achieved by introducing a carbon tax on imports at the border of the Republic of Kazakhstan for goods that are already produced in the country. This approach is similar to the European Union's decision, which from 2023 is implementing a "carbon border adjustment mechanism," analogous to an import duty linked to the carbon intensity of products [16].

Furthermore, innovations in the cement industry are not only limited to economic parameters of cement production but in most cases are aimed at a zero-waste process that positively affects the environment.

Company C Crete Technologies proudly introduced groundbreaking cement-free concrete used in a commercial building in Seattle, a first-of-its-kind innovative product in the construction industry. This environmentally friendly alternative to Portland cement produces virtually no carbon dioxide, and over time, this cement less concrete actually absorbs CO2 from the air [17].

For the purpose of sustainable development of the country's economy, it is necessary to work out issues of its dependence on the construction industry of neighboring states. Table 4 notes that out of the 17 SDGs, three goals (9 and 11) directly or indirectly relate to the development of the construction industry of the economy of Kazakhstan, in particular, the market for the production and use of cement in the country [18].
### Table 4. Implementation mechanisms to achieve the SDGs by 2030, aimed at the process of efficient use of building materials in Kazakhstan

<table>
<thead>
<tr>
<th>No. SDGs</th>
<th>Description of the SDGs</th>
<th>Mechanisms for the implementation and achievement of the SDGs</th>
<th>Expected effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>SDG 9</td>
<td>Building resilient infrastructure, promoting inclusive and sustainable industrialization and innovation</td>
<td>Innovation and technological progress are key to finding long-term solutions to both economic and environmental problems, such as improving resource efficiency and energy efficiency.</td>
<td>Economic effect, social effect, environmental effect</td>
</tr>
<tr>
<td>SDG 11</td>
<td>Ensuring openness, security, resilience and environmental sustainability of cities and towns</td>
<td>Rapid urbanization results in an increase in the number of slum dwellers, inadequate and congested infrastructure and services (such as waste collection and water and sanitation systems, roads and transport), worsening air pollution and unplanned urban sprawl.</td>
<td></td>
</tr>
</tbody>
</table>

Source: [S. Niyazbekova, et al., *Environmental safety in the countries bordering Kazakhstan in the context of sustainable development.* // E3S Web of Conferences, Volume 244 (2021), 01016]

Currently, Kazakhstan is successfully implementing and monitoring the 17 Sustainable Development Goals (SDGs) put forward by the United Nations (UN) in 2015, as the indicators of departmental and sectoral strategic development plans have been aligned with the main target indicators of the SDGs.

## 5. Conclusion

The study showed the growing development of cement production, which is directly related to the increase in the volume of construction work in Kazakhstan. Based on the actual indicators for construction work and the gross domestic product, a correlation-regression model was formed for the forecast of cement production. Issues on innovative solutions in the cement industry were also considered, in particular those related to environmentally friendly production methods and their application in construction work, which is very important in the conditions of sustainable development of the national economy.

In 2023, Kazakhstan experienced an acceleration in inflationary processes, which affected the cement industry within the framework of economic policy. Measures are being taken to ensure the sustainable development of the construction sector as part of implementing an optimal economic policy.

One of the directions involves containing the rise in prices for construction materials. Today, various options are being considered to restrain price increases, all of which, in one way or another, limit competition [19].

Simultaneously, the prospects for the development of the cement industry will be determined by the following directions:

1. Clinker production will decrease due to the use of low or zero-carbon emission cements, becoming one of the most expensive production concerns affecting all investor calculations and decisions. Demand for carbon-neutral fuel will rapidly increase.
2. The number of cement plants in developed countries will decrease by 2050 compared to 2000, and production will shift to third countries.
3. The CO2 content will decrease, but the intensity of using reinforced concrete structures will increase due to urbanization.
4. Global cement prices will gradually need to increase in real terms to reflect the heightened costs of enterprises [20].

References

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17. Produced by C-Crete Technologies, groundbreaking concrete with a revolutionary composition was used for the first time to pour a building in Seattle. Jul 18, 2023 https://www.prnewswire.com/news-releases/c-crete-technologies---301880383.html.

18. S. Niyazbekova, et al., Environmental safety in the countries bordering Kazakhstan in the context of sustainable development. // E3S Web of Conferences, Volume 244 (2021), 01016.
