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Strategic transformation of the precipitated calcium carbonate industry in Indonesia

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Abstract

Purpose. To substantiate strategic approaches for the development of the precipitated calcium carbonate (PCC) industry in Indonesia based on an analysis of the PCC market, taking into account the needs of industrial consumers, market segmentation, product requirements, and the availability of local mineral resources.

Methods. This study employs a mixed-methods approach, combining secondary data from trade statistics, literature reviews, and company reports with primary data from field surveys and interviews. It analyzes import-export trends of PCC using HS codes 28365010 and 28365090, and maps industrial users across Java. Strategic analysis was conducted using the SWOT and BCG matrices to assess the competitiveness and growth potential of domestic PCC production.

Findings. Indonesia's PCC demand reaches 65393 tons per year, while domestic production is only 14600 tons (22%), resulting in an import dependency of around 75%. It creates an import substitution opportunity of 50793 tons per year. The SWOT analysis shows that the main strength is abundant limestone reserves, but production capacity, environmentally friendly technology, and international certification remain limited. Based on the BCG Matrix, the food and transparent plastic sectors are prioritized as "Stars"; paint and cigarette paper as "Cash Cows"; pharmaceuticals and cosmetics as "Question Marks"; and adhesives as "Dogs" with low priority.

Originality. This study links geological potential with strategic industrial development, especially in the context of import substitution and mineral downstreaming policy.

Practical implications. The government needs to simplify licensing and provide downstream incentives to close the 50793-ton import gap. Producers must focus on the food and pharmaceutical segments and meet international certification standards. R&D support and environmentally friendly carbonation technology are important to reduce import dependency by 75%.

Keywords: *precipitated calcium carbonate (PCC); sustainability; strategic management; SWOT; BCG*

1. Introduction

Precipitated carbonate (PCC) is a synthetic form of calcium carbonate widely used across industries for its unique properties, including the ability to control particle size and morphology during production [1]. The primary raw material for PCC is limestone, which undergoes carbonation to produce a versatile compound. The controllable characteristics of PCC make it an essential additive across various sectors, including the paper, rubber, plastic, pharmaceutical, cosmetic, and food manufacturing industries [2]. In the paper industry, PCC is widely used as a filler in product manufacturing to increase surface brightness, density, and smoothness, and to improve the quality of paper products [3]. PCC is also used in the plastics and rubber industries, providing durability and size stability while reducing production costs in the plastics industry and increasing tensile strength and flexibility in product manufacturing in the rubber industry [4]. The pharmaceutical and cosmetic industries also use PCC as an additive that can be safely incorporated into formulations. PCC is also a developer and thickener in cosmetic products [4]. The food manufacturing industry also uses PCC as an additive, especially in calcium food supplements, which help strengthen products while maintaining their quality [3].

Indonesia's limestone potential is spread across 1000 locations in 193 districts in 31 provinces, with total resources of 227.60 billion tons and total reserves of 21.07 billion tons, with sizable reserves located in regions such as East Java and Central Java (Fig. 1), where mining infrastructure and operations are well established [5].

Limestone in Indonesia generally contains a high percentage of calcium carbonate ($CaCO_3$), which is essential for PCC production. The purity level of limestone from different regions can exceed 90%, making it suitable for high-quality PCC applications [6]. The characteristics of limestone consisting of calcite are beneficial for PCC synthesis, but impurities consisting of clay, silica, and other minerals can affect the final characteristics of PCC [7].

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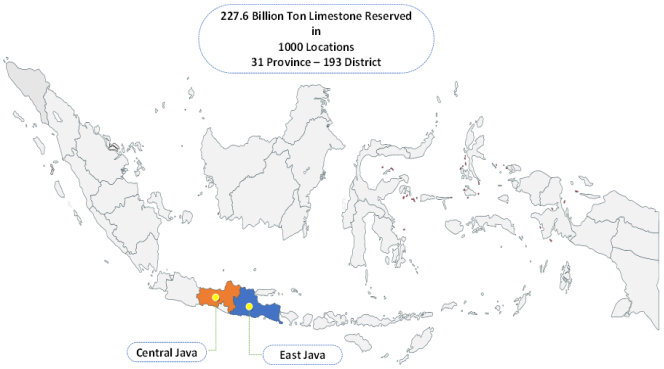

Figure 1. Indonesia's province with the largest limestone reserves

East Java has limestone rich in calcite deposits, making it ideal for producing high-grade PCC [6]. The widespread use of PCC in various industries as a main ingredient or additive will increase the demand for high-purity limestone to produce PCC [8]. Indonesia has the potential to produce high-quality PCC, thereby generating substantial export opportunities. The limestone industry and PCC production can contribute to the local economy by creating jobs in mining, manufacturing, and related sectors.

The global PCC market is projected to grow at a CAGR of 4.7% through 2030, with a market value of USD 2.88 billion [9]. The pharmaceutical, food, cosmetics, and chemical industries are the largest users, with the pharmaceutical sector alone accounting for nearly 47% of the total market value. However, PCC production capacity in Indonesia remains limited, at only around 14600 tons per year from two domestic producers [10]. The high dependence on PCC imports, which reached more than 120 million kg worth USD 32.8 million in 2023 [11], reflects significant opportunities for import substitution. This dependence also increases the risk of global economic turmoil and price fluctuations [12]. Import-substitution strategies will be effective if supported by efficient production technology, an adaptive market orientation, and industrial innovation [13].

Previous research on PCC has focused on production methods, market applications, environmental impacts, and broader economic opportunities. Several studies have discussed various methods for producing PCC from industrial by-products, such as steel slag, post-distillation liquid from the Solvay process, and waste CO_2 [14], [15]. Kazanç et al. [16] discussed the economic feasibility and environmental impact of increasing PCC's added value. Naveed et al. [17] discussed sustainable production practices to reduce environmental impacts, using eco-friendly, cost-effective, and low-cost production methods. Economic opportunities related to the use of PCC in the paper, rubber, plastic, pharmaceutical, cosmetic, and food manufacturing industries in general have also been discussed in many previous studies [2]. Moreover, research on the domestic market's potential to reduce a country's import dependence and on the PCC industry's development strategy is limited. Significant gaps may hinder the development of the PCC industry by enabling the use of domestic resources to reduce import dependence.

The extensive limestone resources as a raw material for PCC manufacturing in Indonesia, the growing global PCC market, and the very high demand of the domestic PCC industry create opportunities for the development of the PCC industry in Indonesia to meet domestic needs and support import substitution. It aligns with the growth of new products using PCC and technological developments, which can create new opportunities to expand the market. This study aims to provide a comprehensive picture of the potential domestic PCC market in Indonesia by identifying and analyzing user needs, segmentation, specifications, and market size. Another objective is to develop appropriate strategies for advancing the PCC industry using local resources and industry needs.

2. Methods and data

2.1. Methods

This study employed a mixed-methods approach, utilizing both secondary and primary data. Secondary data were collected from literature, market reports, statistical databases, trade publications, and company websites to understand the landscape of PCC producers and users in Indonesia and globally. Trade data on PCC imports and exports were obtained from the Indonesian Central Bureau of Statistics (BPS) using relevant Harmonized System (HS) codes, such as 28365010 and 28365090, for calcium carbonate and related chemical compounds. The focus was on Indonesia's import and export trends from 2012 to 2023.

Primary data were gathered through field surveys and interviews to assess potential domestic market segments, product specifications, and pricing. The survey mapped key producers and industrial users in major industrial zones across Java. Interviews with relevant ministries and agencies were also conducted to complement official data and address information gaps related to domestic production, certification, and demand profiles.

2.2. PCC processing method

There are three methods for producing PCC using different raw materials: the calcium chloride ($CaCl_2$) process, which relies on the Solvay process; the Derivation Method; and the carbonation process. Calcium carbonate ($CaCO_3$), often supplied as limestone, is the common feedstock in all processes. The $CaCl_2$ process uses the Solvay process, which combines calcium carbonate with sodium chloride to produce sodium carbonate (Na_2CO_3) and calcium chloride ($CaCl_2$). $CaCl_2$ enhances reaction efficiency and extracts sodium carbonate (Na_2CO_3) as a significant precursor for PCC production [18]. The lime-soda process uses calcium hydroxide ($Ca(OH)_2$), which reacts with soda ash to precipitate $CaCO_3$. The purity and reactivity of limestone after calcination have a robust modulating effect on the process efficiency [19]. These could be optimized to curtail emissions and reduce environmental footprint [20]. The carbonation process, characterized by simplicity and sustainability benefits, involves carbon dioxide flowing through a lime slurry to form $CaCO_3$. The process captures carbon in industrial processes and aligns with the goals of the circular economy [21]. The parameters of efficiency, temperature, pressure, and reactant concentration play a crucial role in determining the yield [22]. The carbonation route has fairly obvious drawbacks, including the number of reaction stages required. However, it is desirable in terms of the material consumption and storage conditions [23]. The three main synthesis processes for PCC are outlined in the flowchart shown in Figure 2.

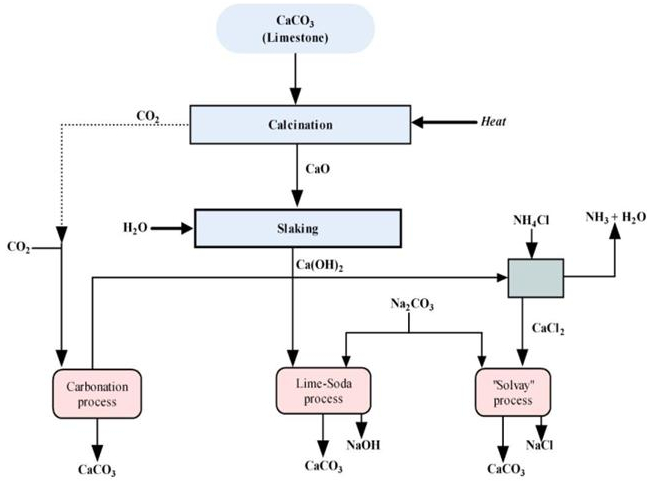

Figure 2. PCC processing method

2.3. Strategic formulation

Modern organizational environments have been marked by the fast and the unexpected, necessitating ongoing strategic planning to enable change and future sustainability. This level of volatility imposes a responsibility on decision-makers to estimate future uncertainties and incorporate innovation into strategic approaches [24], [25]. Empirical studies have verified that the impact of the human resources-enhanced strategic thinking on organizational performance in volatile markets is noticeably positive [26]. Firms will need to consider internal and external factors to develop resilient strategies, such as changes in markets and consumer behavior [27], [28]. The SWOT analysis offers a focused approach to valuing external opportunities and threats, as well as internal strengths and weaknesses [29], [30]. The areas of its application are varied and intersect with the spheres of retail strategy [31], digital marketing [32], disaster mitigation policy [33], and environmental planning [34]. Moreover, SWOT enables collaborative policy formulation and stakeholder coordination in the public sector [35].

The Boston Consulting Group (BCG) matrix is an extension of the SWOT framework that categorizes business units based on market share and market growth into Stars, Cash Cows, Question Marks, and Dogs [36]. This taxonomy helps industries maximize investment and resource distributions [37]. Despite its usefulness, the BCG matrix cannot account for external factors such as consumer trends or market oversaturation, making it most useful when applied alongside SWOT or market segmentation [38]. Combining SWOT with BCG enhances strategic clarity by aligning internal capacities with external opportunities, thereby enabling greater flexibility in responding to market forces [39]. This type of integrated strategy helps with a specific strategic orientation and priority-based investment allocation, particularly in an emerging industry [40]. This paper uses a composite SWOT-BCG analysis of the strategic situation of the PCC industry in Indonesia, based on available domestic assets.

3. Results and discussion

3.1. The development of the PCC industry in Indonesia

This study investigates the PCC industry landscape in Indonesia through field surveys and interviews conducted between August and November 2024 across PCC-using industries in the Jakarta, Bogor, Depok, Tangerang, and Bekasi (JABODETABEK) regions. While domestic PCC production mainly supplies the cigarette paper industry, other sectors, such as pharmaceuticals and food, remain heavily dependent on imports. Trade volume trends for HS codes 28365010 (food/pharmaceutical-grade) and 28365090 (non-food-grade) were analyzed to assess demand.

Interviews with relevant government ministries provided additional data on producer numbers, market segmentation, and industry-specific requirements, helping to contextualize Indonesia's PCC market and highlight gaps between domestic supply and industrial demand. Various industries in Indonesia use PCC in their production, including the paper, cigarette paper, plastic, rubber, adhesive and sealant, coating, and pharmaceutical, cosmetic, and food industries. PCC is mainly used as an additive and filler across various industries due to its adaptable properties, including particle size, morphology, and purity.

3.2. Export volume and value of HS Code 28365010

The volume and value trends of exports under HS Code 28365010 are illustrated in Figure 3, which shows fluctuations in export volume in 2019 triggered by changes in consumer paradigms that led to industrial shifts.

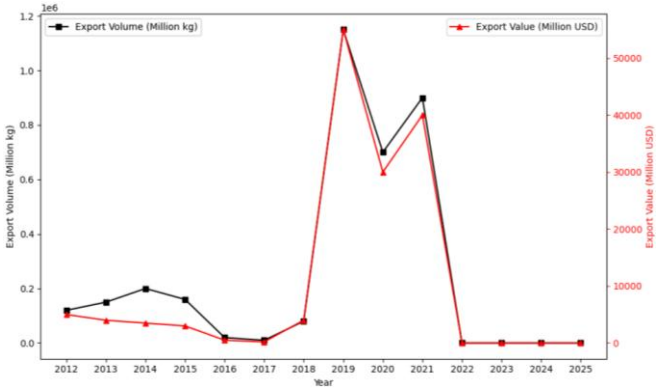

Figure 3. Export trend market of HS Code 28365010

The surge in volume from 80 thousand kg in 2018 to 1.25 million kg in 2019 reflects temporary international market penetration. However, exports declined sharply and stagnated close to zero between 2022 and 2025. It is due to the limited domestic supply, while domestic demand in the pharmaceutical and food sectors continues to increase, in line with the national policy on downstream mineral processing. Although the 2012-2022 period shows a CAGR of 11.04%, stagnant export growth indicates that local production is fully absorbed.

3.3. Export volume and value of HS Code 28365090

The trend in export volume and value for HS Code 28365090 shown in the graph in Figure 4 indicates a significant decline, with a CAGR of -22.85%. Export volume fell sharply from around 45 million kg in 2012 to almost zero in the 2023-2025 period. Despite a brief recovery between 2016 and 2020, the downward trend indicates the vulnerability of local producers to price pressures from large-scale global competitors. The absence of any meaningful trend movement after 2022 indicates that limited domestic production is now fully absorbed by high-absorption local industries, such as paint, paper, and plastics. It shows that the current market reality has shifted from global export competition to the strict expansion of domestic production capacity for import substitution.

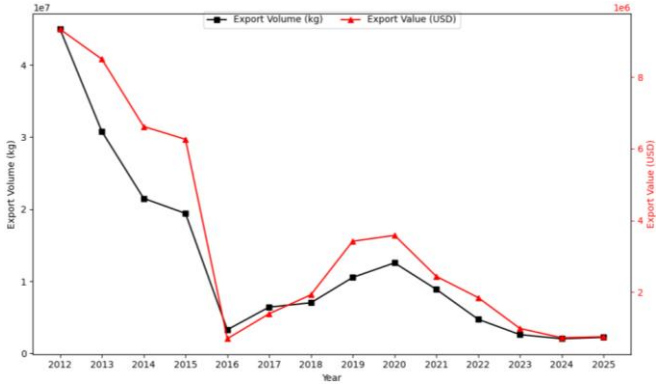

Figure 4. Export trend market of HS Code 28365090

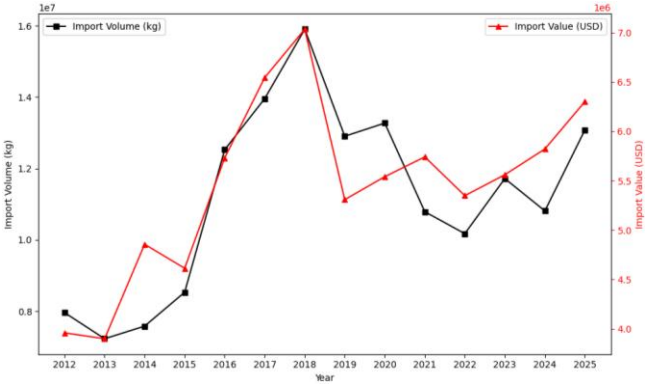

Figure 6. Import trend market of HS Code 28365010

3.4. Export price of HS Code 28365010 and HS Code 28365090

The export prices for HS codes 28365010 and 28365090 for the period 2012-2023 are shown in Figure 5, which shows fluctuations in export prices for both types of PCC, with a clear trend of added value evident for food and pharmaceutical applications under HS code 28365010.

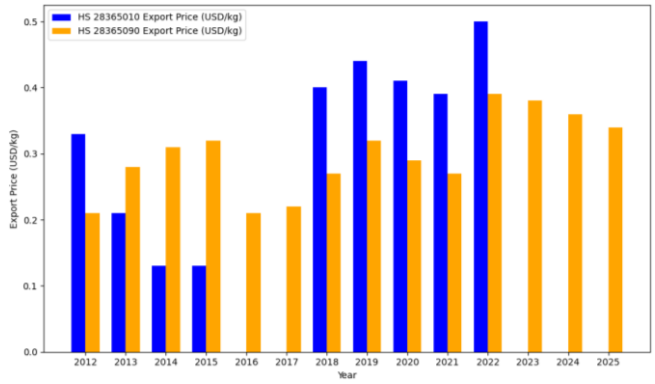

Figure 5. Export price of HS Code 28365090 and HS Code 2836510

The unusual price decline between 2013 and 2015 was likely due to exports of low-quality batches. Premium quality gradually recovered, peaking at USD 0.50/kg in 2022. The absence of price data for HS Code 28365010 from 2023 to 2025 fully confirms the volume discussed in sub-section 3.2 in Figure 3, where there was a total suspension of premium exports in favor of domestic market absorption. A different picture is presented by the price of industrial-grade PCC under HS Code 28365090, which has remained relatively low, averaging around 0.35 USD/kg in recent years. This fluctuating price difference indicates that domestic producers have limited profit margins when competing in the global industrial-grade market. Future developments in PCC production capacity should focus on high-purity, high-margin PCC for food and pharmaceutical products, thus maximizing economic returns and effectively replacing expensive imported products.

3.5. Import volume and value of HS Code 28365010

The import trend for HS code 28365010 is illustrated in Figure 6, which shows an increasing reliance on foreign supplies. The peak trend occurred in 2018 at 15.9 million kg, followed by a period of little change in import trends until a sharp increase from 2022 to 2025, reaching 13 million kg.

It is directly driven by the expansion of Indonesia's domestic pharmaceutical and food sectors, which require high-purity standards that local producers cannot yet meet on a large scale. The long-term CAGR of 3.58% makes the value and volume of imports critical after seeing this gap. The continuously increasing import trend presents a highly profitable, rapid opportunity to replace domestic imports, provided that local producers receive technological and regulatory support to obtain the necessary international certifications.

3.6. Import volume and value of HS Code 28365090

The dynamics of PCC imports under HS Code 28365090 for the industrial class, as shown in Figure 7, indicate a significant and growing dependence on external markets. After experiencing a significant decline in 2014 to around 57 million kg, the import trend has been steadily increasing, peaking between 2022 and 2025, with volumes exceeding 130 million kg and import values also reaching record highs during this period. This growth is marked by a 7.7% CAGR, clearly highlighting the inability of domestic producers to meet demand from the rapidly growing local sector, particularly in the paint, paper, and transparent plastic industries. The continuous import process confirms that, despite abundant local limestone resources, domestic manufacturing infrastructure remains severely underdeveloped. Therefore, addressing this significant volume gap must be a key pillar of Indonesia's industrial transformation strategy to stop the outflow of foreign exchange.

3.7. Import price of HS Code 28365010 and HS Code 28365090

Figure 8 illustrates the consistent and significant price difference between the two grades of PCC during the period 2012-2025. Food and pharmaceutical-grade PCC, HS Code 28365010, made a significant contribution, peaking at USD 0.64/kg in 2014 and stabilizing at USD 0.48-0.55/kg in recent years. This sustained contribution directly reflects the strict international purity certification and advanced manufacturing technology required by these sectors. In contrast, the price of industrial-grade PCC under HS Code 28365090 remains much lower, consistently ranging from 0.20 to 0.38 USD/kg. Indonesia's dependence on imports of expensive premium products represents a significant outflow of capital. Therefore, the domestic PCC industry must avoid direct price wars with cheap, mass-produced industrial imports. Instead, strategic investments should prioritize technological upgrades and certification acquisitions to replace the high-margin food and pharmaceutical import markets.

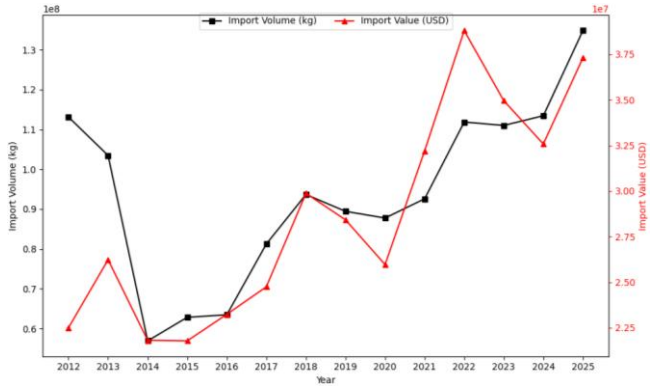

Figure 7. Import trend market of HS Code 28365090

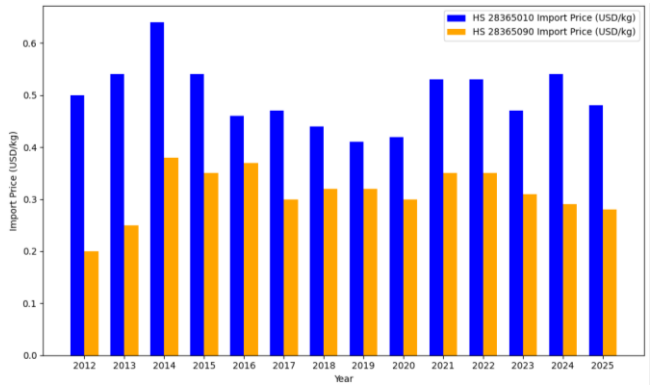

Figure 8. Import price of HS Code 28365090 and HS Code 28365010

3.8. Import volume by country of origin for HS Code 28365010

The latest import data based on country of origin for high-quality PCC is shown in Figure 9, which illustrates the shift in the PCC supply chain in Indonesia. The market is now dominated by emerging regional manufacturing hubs, including Vietnam (35.58%) and India (24.46%), followed by Malaysia (16.99%). These three countries account for more than 77% of Indonesia's high-quality PCC supply. This extreme market concentration makes Indonesia's food and pharmaceutical sectors vulnerable to disruptions in the existing supply chain, including regional trade disruptions, geopolitical shifts, or sudden export restrictions from these countries. Therefore, building appropriate domestic production capacity is no longer just an opportunity for economic import substitution but a necessity to secure the national supply chain in essential industrial sectors.

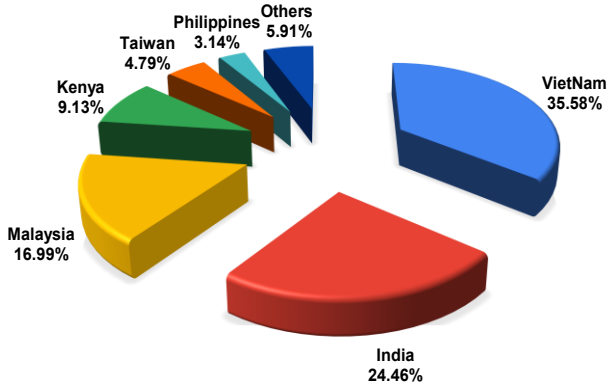

Figure 9. Import volume by country of origin for HS Code 28365010 in 2025

3.9. Import volume by country of origin for HS Code 28365090

The distribution of imports for industrial-grade PCC, illustrated in Figure 10, highlights the shift in regional competition. Vietnam is aggressively displacing traditional suppliers to become the main source, controlling 40.7% of the market, followed by Malaysia (26.1%), Taiwan (14.6%), and China (12.6%). Vietnam's large supply flow demonstrates highly optimized large-scale manufacturing capabilities and price competition that is very difficult for developing Indonesian manufacturers to match. Direct competition with Vietnam's low-cost, mass-production PCC industry will cause significant erosion of local companies' profit margins. Conversely, policymakers and industry stakeholders must recognize the intense regional competition in the low-end market as a signal to shift domestic strategic investment toward high-quality products that rely on imports.

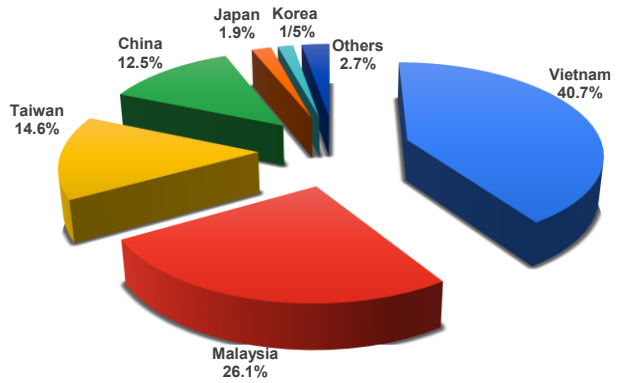

Figure 10. Import volume by country of origin for HS Code 28365090 in 2025

3.10. Domestic PCC manufacturers

Based on field surveys and interviews with relevant ministries, only two companies currently produce PCC domestically in Indonesia: PT Light Calsindo Raya and PT Niraku Jaya Abadi. PT Light Calsindo Raya, with a production capacity of 6800 tons/year (previously 10400 tons in 2019), supplies multiple industries, including paint, plastic, rubber, paper, pharmaceuticals, and fiberglass. Its PCC pro-duct has 98-99% $CaCO_3$ content, 0.20-0.25% MgO, $\leq$ 0.03% Fe, a surface area of 14000-32000 cm^2/g, and a particle size of 1.0-1.5 µm. Despite declining production, the price remains stable at USD 0.37/kg (Rp 16000/USD), ensuring competitiveness. PT Niraku Jaya Abadi produces 7800 tons/year for food, plastics, rubber, polymers, agriculture, and palm oil processing. Its PCC offers $\geq$ 99% $CaCO_3$, a bulk density of 0.45-0.55 g/cc, and 99% whiteness/brightness. It is suitable for food-grade and sensitive applications, with a particle size of 1.0-1.5 µm, and is free of heavy metals and pathogens. The product is priced at USD 1.5/kg, reflecting its premium quality and strict specifications.

3.11. SWOT analysis

Indonesia has significant potential to develop strategic industries such as PCC, given its abundant resources. Indonesia's limestone reserves are estimated at around 227.6 billion tons, distributed across several regions, including East and Central Java [5]. Several regions, such as East and Central Java, have high-quality limestone with 90% calcium carbonate content, which can serve as a raw material for developing the

PCC industry to support the government's downstreaming program for minerals [6]. Furthermore, there are already local industries capable of producing high-quality PCC, namely PT. Niraku Jaya Abadi and PT. Light Calsindo Raya, with a purity level of 98%, good brightness, and a precise particle size of around 1-1.5 µm. Purity level and particle shape are important specifications for PCC products applied in the pharmaceutical and food sectors. There should be no impurities that could affect the product's effectiveness and safety [41], [42]. The advantages of this quality include opportunities and a strong foundation for the domestic PCC market's resilience, as PCC use across industries is currently increasing.

Despite abundant resources, the PCC industry still faces various obstacles in its development. The main obstacle at present is that domestic production meets only 22% of total national demand, with 75% still dependent on imports. In addition, domestic industrial production is still dominated by conventional synthesis methods that are energy-intensive and inefficient. The application of modern carbonation technologies, such as closed-loop CO_2 recycling, remains very limited, even though it can reduce carbon emissions, lower operational costs, and improve product quality [43], [44]. Another obstacle is the lack of cooperation between research institutions and industry players, which slows product innovation and makes it difficult for research results to be sufficiently competitive to be developed into high-value export products [45].

The greatest opportunity for the PCC industry lies in increasing domestic production capacity, particularly for high-quality products that can substitute for imports in the pharmaceutical and food sectors. Law No. 3 of 2020 concerning Mineral and Coal Mining and Law No. 6 of 2023 concerning Job Creation are forms of government support in the form of regulations that can provide fiscal incentives, ease licensing, and offer investment facilities, thereby strengthening the competitiveness of the national industry [46].

However, realizing these opportunities is not easy due to significant external challenges. Large-scale global producers have high energy efficiency and high production volumes, enabling them to offer lower prices than domestic producers that are still developing [47]. These factors put the domestic industry under price pressure from highly competitive imported products. In addition, dependence on imported carbonation equipment and technology makes domestic production costs vulnerable to exchange rate fluctuations and global price instability [48]. Another issue is the need for complex, expensive, and time-consuming international certification, which is a significant barrier for local businesses [49]. The potential for regulatory overlap between the mining and chemical sectors lengthens the environmental licensing process and creates investment uncertainty, thereby increasing business risk [50]. Figure 11 shows a complete SWOT analysis.

3.12. BCG matrix

Mapping the PCC user industries in Indonesia to the BCG Matrix in Figure 12 was based on three main factors: the extent of domestic PCC use, the quality of PCC required by each industry, and current import conditions. The position of each category is determined by the industry's technical requirements and the current market situation. The food and transparent plastics industries are categorized as "Stars" because they have strong market growth and significant potential for a large domestic market share. PCC has advantages due to its neutral properties, bright white color, and ability to meet strict food safety standards [51].

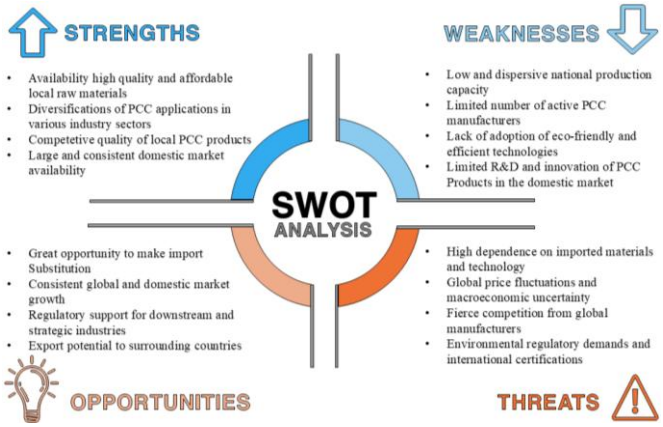

Figure 11. SWOT analysis

Meanwhile, the transparent plastic industry uses nano-PCC measuring < 1 µm as a filler material that can maintain optical clarity while improving the mechanical strength and visual quality of packaging materials [52], [53]. It means that domestic industry development needs to focus on high-quality PCC product segments and be pursued seriously to reduce dependence on imported high-quality products.

The paint and cigarette paper industries fall into the "Cash Cow" category, which has the largest and relatively stable demand volume segment in the country. The paint industry absorbs around 37 thousand tons of PCC per year, while the cigarette paper industry absorbs around 14400 tons. PCC functions as a functional filler that can reduce production costs by replacing expensive pigments, such as titanium dioxide, without compromising opacity or dispersion quality [54], [55]. Although market growth tends to be stable and import prices for industrial-grade products are relatively low, local producers can still take advantage of this large-volume segment to maintain operational efficiency and basic profit stability.

However, the pharmaceutical and cosmetics industries fall into the "Question Marks" category. Despite relatively high growth in the domestic market, this segment remains dominated by imported products due to stringent technological barriers. PCC in the pharmaceutical industry acts as an excipient in tablets, while in cosmetics, it is used as a mild abrasive that is safe for the skin [56], [57]. The very high purity requirements and the need for expensive and complex international certification make it difficult for local manufacturers to penetrate this market. Therefore, significant investment in research and development and technological improvements is needed for this segment to grow into a "Star" category in the future.

The adhesive industry falls into the "Dog" category. The segment in this industry only absorbs a small portion of domestic PCC demand, around 7640 tons, and has low growth potential. PCC is used in small proportions (around 25%) in adhesive formulations and can be easily replaced by other, cheaper, and more abundant local minerals, such as kaolin and clay [58]. The segmentation of this industry does not provide significant long-term value for industry growth. Therefore, domestic PCC producers should reduce their technical and financial focus on this segment and shift their priorities to high-value-added products that still depend on imported inputs. The complete BCG matrix of PCC user industries in Indonesia is presented in Figure 12.

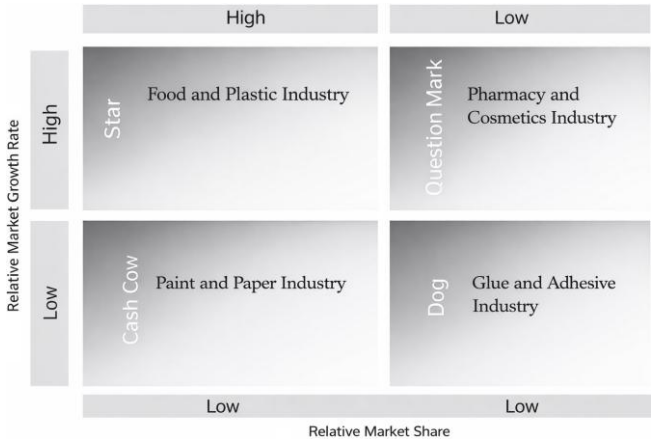

Figure 12. BCG matrix for Indonesia's PCC industry

4. Conclusions

The current domestic demand of PCC in Indonesia is about 65393 tons per annum. It is led by the paint industry (37000 tons), cigarette paper (14400 tons), adhesives (7640 tons) and rubber/tires (6353 tons). The domestic production capacity is 14600 tons, indicating a large opportunity for import substitution of 50793 tons.

According to a SWOT analysis, some of the industry's strengths include abundant local raw materials and extensive use of PCC. Its main weaknesses include poor production capacity, few producers, and a lack of environmentally friendly technology and international certification. However, there are incentives for import substitution, market expansion, regulatory incentives for mineral downstreaming, and possible exports to ASEAN and South Asia. The threats of price pressure from cheap imported goods, exchange rate volatility, and international laws and regulations remain major concerns that should be taken seriously.

The food and transparent plastics segments fall in the BCG Matrix under the Stars due to high growth potential; paint and cigarette paper fall in the Cash Cow category since they provide stable cash flows; and pharmaceuticals and cosmetics fall under the Question Marks category since they have high potential yet to be realized. The adhesives fall under the Dogs category since they make little contribution. The strategic development plan of the national PCC industry must therefore focus on capacity building based on the use of local raw materials, sustainable CO_2 carbonation technology, product quality enhancement to international standards, and integration with other major user industries. Such goals require the synchronization of policy actions by central and local governments and collaboration among industry stakeholders, research institutes, and other interested parties.

It is advisable to conduct a continuity study to build a practical national PCC roadmap, a feasibility study of CO_2 carbonation technology, and to explore export opportunities to substitute for imports and expand markets. Overall, the PCC industry's development holds significant economic potential and aligns with Indonesia's goal of developing a self-sufficient, competitive green industry.

Author contributions

Conceptualization: NW, RW; Data curation: NW, RW, IM, HH, S; Formal analysis: NW, RW; Funding acquisition: RW; HPS; Investigation: RW, IM, HH, S; Methodology: NW, SH; Project administration: RW, HH; Resources: NW, RW, IM, HH, S; Software: NW; Supervision: NW, RW, HPS, SH; Validation: NW, RW; Visualization: NW; Writing – original draft: NW, RW; Writing – review & editing: NW, RW, HPS, IM, HH, S, SH. All authors have read and agreed to the published version of the manuscript.

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Conflicts of interests

The authors declare no conflict of interest.

Data availability statement

The original contributions presented in the study are included in the article, further inquiries can be directed to the corresponding author.

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Стратегічна трансформація індустрії осадженого карбонату кальцію в Індонезії

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Мета. Обґрунтування стратегічних підходів до розвитку індустрії осадженого карбонату кальцію (ОКК) в Індонезії на основі аналізу ринку ОКК з урахуванням потреб промислових споживачів, сегментації ринку, вимог до продукції та наявності місцевої мінеральної сировинної бази.

Методика. У дослідженні застосовано змішаний підхід, що поєднує вторинні дані зі статистики зовнішньої торгівлі, оглядів літератури та звітів компаній із первинними даними польових обстежень та інтерв'ю. Проаналізовано тенденції імпорту й експорту ОКК за кодами HS 28365010 та 28365090, а також здійснено картування промислових споживачів на острові Ява. Стратегічний аналіз проведено з використанням матриць SWOT та BCG для оцінювання конкурентоспроможності й потенціалу зростання внутрішнього виробництва ОКК.

Результати. Визначено, що попит на ОКК в Індонезії становить 65393 т на рік, тоді як внутрішнє виробництво сягає лише 14600 т (22%), що зумовлює імпортозалежність на рівні близько 75% й створює можливість імпортозаміщення обсягом 50793 т на рік. SWOT-аналіз показує, що основною перевагою є значні запаси вапняку, однак виробничі потужності, екологічно "дружні" технології та міжнародна сертифікація залишаються обмеженими. Згідно з матрицею BCG, пріоритетними як "Stars" визначено харчову промисловість і сектор прозорих пластиків; "Cash Cows" – виробництво фарб і сигаретного паперу; "Question Marks" – фармацевтичну та косметичну галузі; "Dogs" – виробництво клеїв, яке має низький пріоритет.

Наукова новизна. У дослідженні комплексно поєднано оцінку геологічного та сировинного потенціалу виробництва ОКК з аналізом внутрішнього попиту, імпортозаміщення та стратегічного розвитку галузі. Новизна полягає в інтеграції ресурсного, ринкового і стратегічного підходів для обґрунтування пріоритетних напрямів розвитку національної ОКК-індустрії в умовах поглибленої переробки мінеральної сировини.

Практична значимість. Рекомендовано уряду спростити процедури ліцензування та запровадити стимули для розвитку переробки з метою скорочення імпортного розриву у 50793 т, а виробникам слід зосередитися на харчовому та фармацевтичному сегментах і забезпечити відповідність міжнародним стандартам сертифікації. Підтримка досліджень і розробок, а також впровадження екологічно безпечних технологій карбонізації є важливими для зниження імпортозалежності, яка на сьогодні становить 75%.

Ключові слова: *осаджений карбонат кальцію (ОКК); сталий розвиток; стратегічний менеджмент; SWOT*

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