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Industry Direction™

Looking ahead in 2023: Collaboration, Partnership and Innovation in the Limestone Industry

The Market

The limestone market consists of sales of limestone products by entities (organizations, sole traders, and partnerships) that are used in steel production, paper manufacturing, plastic manufacturing, water treatment and purification, and mining. It is a sedimentary rock composed mainly of calcium carbonate (calcite) or calcium-magnesium double carbonate (dolomite). It contains microscopic fossils, shell pieces, and other petrified trash. Limestone is often grey in colour, although it can also be white, yellow, or brown. Limestone may be found in aggregates, cement, building stones, chalk, and crushed stone, and it is frequently used in road and building construction.

The main types of limestone are magnesian limestone and high-calcium limestone. High-calcium limestone refers to

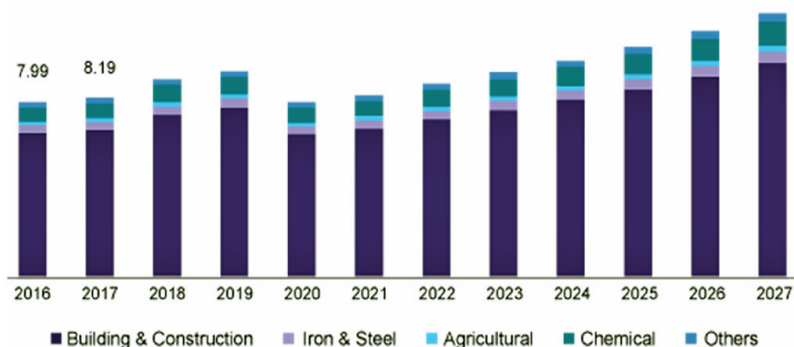
limestone that is primarily calcium oxide or calcium hydroxide and includes not more than 5% magnesium oxide or hydroxide. These types of limestone are categorized based on their size, which includes crushed limestone, calcined limestone (PCC), and ground limestone (GCC). The various types of limestone are segregated based on application, which includes industry lime, refractory lime, chemical lime, and construction-based lime. The major end-user segments for limestone are paper and pulp, water treatment, agriculture, building and construction, plastics, food and beverage, and others.

The Future

The global limestone market size is expected to grow from \$65.08 billion in 2021 to \$68.32 billion in 2022 at a compound annual growth rate (CAGR) of 4.97%. The global limestone market size is expected to grow to \$86.75 billion in 2026 at a compound annual growth rate (CAGR) of 6.15%.

The increasing demand from the construction industry is driving the growth of the limestone market. The construction industry has surged after the pandemic as many construction projects were stuck due to lockdowns. Cement is manufactured using limestone as a raw material. Cement is an important element in the construction industry because it is used in various construction mixtures, such as the manufacture of composite

The U.S. limestone market size, by end-use, 2016 - 2027 (USD Billion)



Source: www.grandviewresearch.com

concrete blocks, to meet specific needs in holding building blocks. According to the U.S. Census Bureau report on monthly construction spending in 2022, construction spending was expected to be \$1,744.8 billion in April 2022, a 0.8% rise from the revised March 2022 estimate of \$1,740.6 billion. Therefore, the increasing demand from the construction industry is propelling the limestone market.

Partnership, Collaboration and Innovation

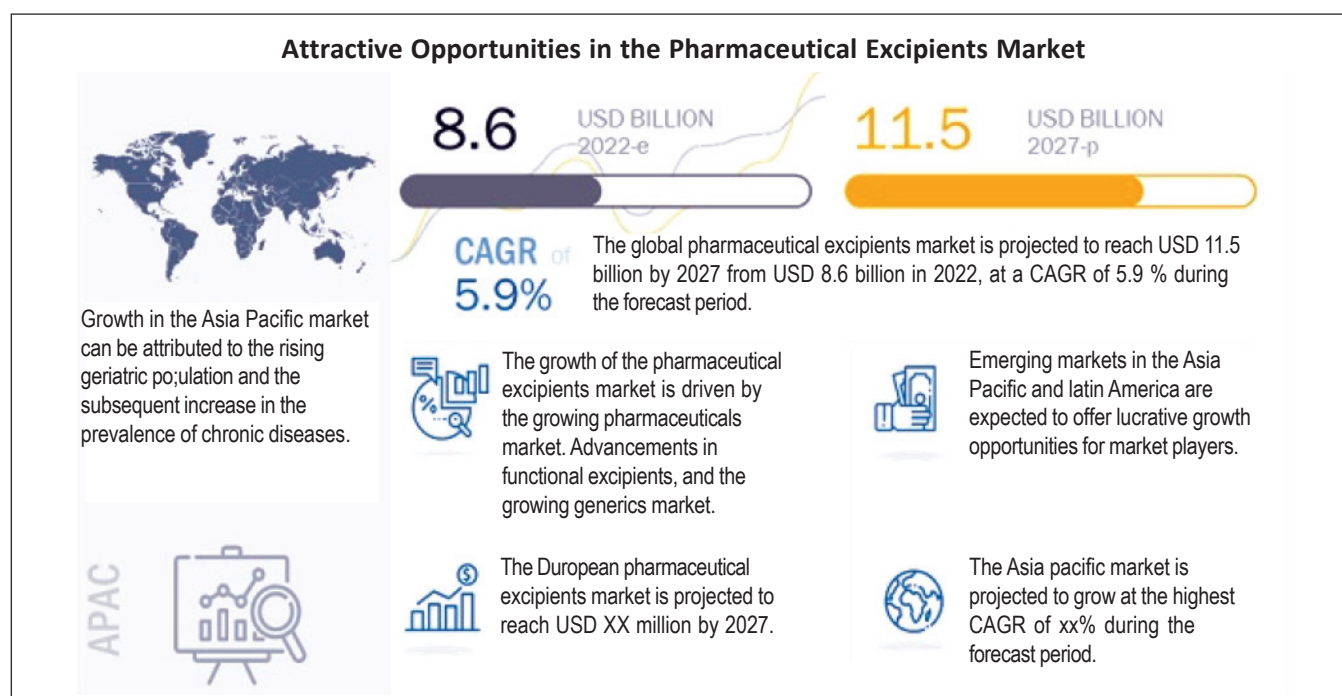
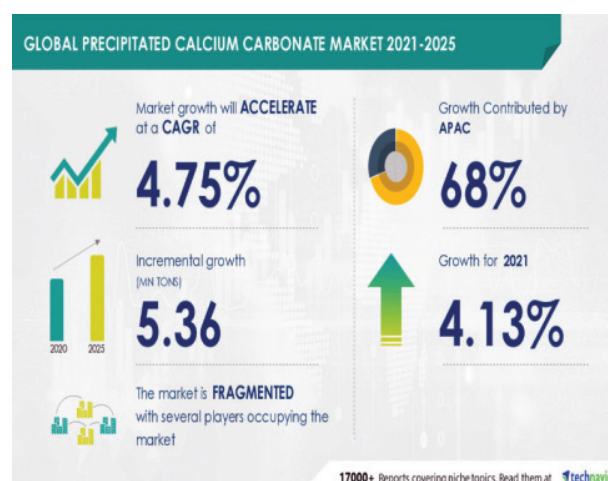
Strategic partnerships, collaborations and innovations are a key trend in the limestone market. Organizations enter into partnerships and collaborations to expand into new markets and leverage each other's resources. In May 2020, Biesterfeld Spezialchemie, a Germany-based provider of products and solutions for specialty chemicals, entered into a partnership with Omya. This partnership will expand Biesterfeld's product range to include new pharmaceutical excipients, active components, and nutraceutical goods. Omya is a Switzerland-based producer of calcium carbonate-based specialties.

Excipient Market

Biesterfeld Spezialchemie has entered into a distribution partnership with Omya, the leading producer of calcium carbonate-based specialties in 2020. The collaboration covers the pharmaceutical and nutraceutical sectors. With immediate

effect Biesterfeld will distribute the Swiss manufacturer's innovative excipients and active ingredients Omyapure®, Calcipur® DC and Omyapharm®. The new agreement applies in Germany and Austria.

Thanks to the new distribution partnership, the product portfolio will be expanded to include innovative pharmaceutical excipients and active ingredients, as well as products for nutraceuticals. These include Omyapure®, a natural calcium carbonate used as a pharmaceutical active ingredient, for example as an acid blocker or for the prevention of osteoporosis. Calcipur® DC is a directly compressible calcium carbonate, used in the nutraceutical sector as an excipient in the manufacture of tablets and characterised by its ease of use.



Omyapharm® is an innovative, multifunctional pharmaceutical excipient (co-processed excipient), used in the manufacture of solid dosage forms (tablets, capsules, granules) in the pharmaceutical industry. Omyapharm® delivers remarkable results in terms of compactability and its ability to absorb liquids. The combination of high hardness together with its fast disintegration is particularly impressive. Thus, orodispersible tablets (ODTs) made with Omyapharm® particularly dissolve in the mouth within only few seconds. As a result of these outstanding properties, the product was awarded in 2015 with the CPHI Innovation Award as the best Innovation in APIs and Excipients.

“Biesterfeld will be a strong and reliable partner for us. With their proven experience in the pharmaceutical sector and

technology-based consulting, Biesterfeld’s experts can offer a comprehensive range of services. These are the optimum prerequisites for placing our products on the market in the best possible way and to develop the business together,” says Dr. Javier Camargo, Global Business Development Manager, Pharmaceuticals and Nutraceuticals, at Omya.

“We are very pleased about the trust our partner Omya has placed in us with these distribution rights,” said Dr. Andreas Lekebusch, Health Care Business Manager at Biesterfeld Spezialchemie. “This partnership allows us to significantly expand our product portfolio with active ingredients and the innovative excipient Omyapharm® and we are very pleased to be able to provide our customers with comprehensive advice and support in the development of solid dosage forms.”

Table 1

	Characteristics	Benefits	Comments	Attention
1	Compressive strength	likely minimum 5% increase after 28 days	A nominal value of Rs.7000 for 20 bags@50 Kg each considered.	0.5% by weight can provide better results
2	Clinker grinding time reduction	Reduced from 80 mins to 70 mins with the addition. If consistent ,in 12 batch cycles it can give 13 batches in the shift time.	Considering 6 persons directly or indirectly involved with average Rs.200.00 per hour CTC for an 8 hour shift with 13 cycles against current 12 cycles.	There can be different results with 0.5% addition
3	Energy saving	The reduction of grinding time saves precious energy. The energy saving in grinding time reduction is 6kWh per batch. At Rs.7.00 per Kwh and increasing it is a saving of Rs.42.00.	The electrical energy consumed is typically 95 to 120 kWh per ton of cement. The clinker grinding stage accounts for approximately 40% of the electric energy.	This provides Carbon Dioxide reduction in the plant per tonne of cement of at least 6%
4	Residue reduction	Zelcarbon helps grinding and reduces residue by nominal 15%.If 15% residue in current practice is produced per tonne of cement, it means the residue produced will be 12.75% or 128 kg as against 150 kg.		
5.	The LC and AC results	There is no change in the values with or without addition	It means that the cement produced has identical properties to that of the cement without Zelcarbon	
6.	Major changes in PPC composition	Zelcarbon addition in PPC can increase 28 days strength by a minimum of 10%	This can facilitate addition of more slag (% w/w) yet getting the desirable strength.	Getting slag is relatively easier than the limestone and gypsum. Strategically, this will be a good move in the long run.
7.	Lighter cement with added strength	Lighter but stronger structure		Various specialty applications like putty

Innovations in Clinker Additives

In 2022, a new Indian startup Zelence Industries (myzelence.com) claimed that their graphene similar carbon, Zelcarbon derived from agricultural residue can provide unique process and product benefits for various types of cement. Proprietor of Zelcarbon (a patented product) is Zelence Industries Private Limited.

The claims are as shown in Table 1.

Non-tangible benefits

1. Better energy efficient cement.
2. Low carbon Dioxide emission.
3. Low workplace pollution per tonne of cement.

NANOGRAPHI EXPLAINS

What is the difference between

Graphene Oxide and Reduced Graphene Oxide ?



The structure of Zelcarbon© is similar to the combinations of the above three

4. Branding
 5. Untried but related value added products
- Zelence also has provided its experimental results, tested in a Cement plant as shown in Tables 2 to 4:

Table 2: Compressive strength % change in OPC cement

Set 1 (Control)	Set 2 (0.25)	% increase	Set 3 (0.5)	% increase	Set 4 (1.0)	% increase	Set 5 (2.0)	% increase
Day 1 31.7	31.0	-2.208	30.3	-4.416	29.2	-7.886	28.5	-10.094
Day 3 38.5	39.3	2.077	39.2	1.818	39.9	3.636	39.4	2.33
Day 7 43.3	45.9	6.004	46.4	7.15	46.9	8.314	43.9	1.385

Table 3: Compressive strength % change in PPC cement

Set 1 (Control)	Set 2 (0.25)	% increase	Set 3 (0.5)	% increase	Set 4 (1.0)	% increase	Set 5 (2.0)	% increase
Day 1 14.3	15.6	9.090	14.0	-2.097	15.2	6.293	14.6	2.09
Day 3 24.8	26.0	4.838	25.1	1.209	26.0	4.838	25.1	1.209
Day 7 29.7	36.0	21.212	36.4	22.558	37.50	26.26	32.70	10.10

Table 4: Compressive strength % change in CC cement

Set 1 (Control)	Set 2 (0.25)	% increase	Set 3 (0.5)	% increase	Set 4 (1.0)	% increase	Set 5 (2.0)	% increase
Day 1 11.8	12.0	1.694	13.0	10.169	13.0	10.169	12.5	5.932
Day 3 28.10	31.60	12.455	32.50	15.658	33.50	19.217	28.70	2.135
Day 7 37.20	40.40	8.60	42.20	13.44	42.90	15.32	38.70	4.03