MA'ADEN
Local Content Downstream Investment Opportunities

Introduction

The Saudi Arabian Mining Company (Ma'aden) has been identified as the national champion for the mining industry in KSA. Inspired by Vision 2030, and with the Kingdom's geological potential, Ma'aden is set to grow and champion the development of the mining sector. A critical element of this role is the development of Local Content in KSA - to create opportunities for new and existing businesses, and individuals, in the mining industry supply chain and in the wider economy through the supply of materials and products produced by the mining industry.

To support the development of new businesses and new industries based on the outputs of the mining industry Ma'aden has produced the following document that highlights 36 application opportunities based on Ma'aden own production. Investors are invited to examine the opportunity areas that have been identified. Building new businesses and industries in KSA based on the production of the domestic mining industry supports the Vision 2030 objective to diversify the national economy, and to do so with high levels of supply chain Local Content. It also allows investors to secure supply for vital raw materials with shortened supply chains and reduces the supply risk associated with international supply chains.

These opportunities have been separated into three groups based on the Ma'aden Affiliate that produces them – Aluminium, Phosphate and Industrial Minerals. For each opportunity high level information is provided on the opportunity, the end use application, the feedstock requirement that could be supplied by Ma'aden, and a view on the size of the market for the end product. It is intended to provide new and existing businesses with an initial view on where potential opportunity exists to build new investment opportunities based on the output of the Saudi Arabian mining industry. Having reviewed these opportunities should you wish to discuss any of them with Ma'aden, or have any questions, please contact us at:

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Aluminium Foil

Application Perspective

Opportunity Overview

Aluminium foils are made by rolling aluminium slabs cast from molten aluminium in a rolling mill to get the desired thickness. Aluminium foils are pliable and can be easily wrapped around objects. They are light weight, durable, aesthetic, corrosion resistant and are electrical and thermal conductive in nature.

End-Use Applications

Aluminium foils are widely used in

- Food Packaging
- Industrial applications
- Pharmaceutical packaging
- Consumer packaging etc.

Feedstock Requirement

- Aluminium ingots or re-roll stock.
- Foil is generally made from an aluminium alloy which contains between 92-99% aluminium.

Market Sizing

Due to its versatility, ease of use and easy recyclability, aluminium foil turns out to become one of the most consumed aluminium products across the world. As of 2020, global aluminium foil market is expected to witness a growth rate of ~5-5.5% between 2021-2025. Demand picked up pace from 2017-2018, with the advent of rise in commercial food service sector, increased demand for blister foils from pharmaceutical sector and growth in consumer foil packaging.

GCC Regional Demand —

110,000-120,000 tons as of 2020

Global Aluminium Foil Demand

Key Countries Supplying

As of 2019, global trade of Aluminium foil stood at ~$11.5 Bn. Asia-Pacific dominates the market both in terms of production and consumption on the back of population and demand from food and pharmaceutical sectors. On a global scale, China accounts for more than 60% of the global production. China's supply is backed by more local availability of feedstock, number of manufacturing units and many larger scale plants, compared to other countries.

Business Perspective

Plant Level Estimates

4.0-6.0 Ktpa **(Ideal Capacity)**
6-7 USD Mn **(Investment Estimate)**
7,000-7,500 Sq. Mts **(Land Requirement)**
4-7 USD Mn **(Net GDP Contribution from Operations)**
100-120 **(Potential Employment Impact)**
20%-30% **(IRR)**
Direct Investment Model, Joint venture **(Ideal Investment Model)**

Scalability & Localization

- Saudi Arabia has the largest integrated aluminium business in the region, which helps in easy procurement of raw materials for production
- Primary and semi-finished Aluminium products are available in the kingdom at competitive prices. This in turn establishes a solid foundation for developing high value-added Aluminium products for various end-use sectors

HSE Implications

Storage

Produced foils must be stored in heat safe environment. Exposure to ignition sources leads to thermal decomposition and release of irritating gases and vapours such as fumes of aluminium oxide.

Aluminium Powder

Application Perspective

Opportunity Overview

Aluminium powder is a fine granular powder made from Aluminium. Aluminium powder is a light, silvery-white to grey, odourless powder and a reactive flammable in nature. The expanding applications of aluminium powder in the mining, military, chemical, aerospace, automotive and construction industries, depicts market growth for Aluminium powder.

End-Use Applications

Aluminium powders are used in paints, pigments, protective coatings, printing inks, rocket fuel, explosives, abrasives and ceramics; production of inorganic and organic aluminium chemicals; and as catalysts.

Feedstock Requirement

Aluminium powder is produced by melting aluminium ingot in a gas furnace and spraying the molten metal under high pressure into a fine granular powder.

Market Sizing

As of 2020, global aluminium powder market is expected to witness a growth rate of ~2-2.5% between 2021-2025. Increased demand from Construction and electronics industry will be the major driving factor of growth in the short term. On the other hand, Industrial, chemicals and Defense & Aerospace industries for aluminium powder are significantly helping the market to grow.

Middle East Regional Demand —

13-14 thousand tons as of 2020

Global Aluminium Powder Demand

Key Countries Supplying

As of 2019, global Aluminium powder trade was valued at ~$705 million. Aluminium powder trade is heavily dependent on local demand from industrial and manufacturing sector. Countries such as China and US are on the list of top importers as the demand from industrial sector is high compared to domestic production, even with the availability of huge local resource base.

Business Perspective

Plant Level Estimates

6.0-8.0 Ktpa
(Ideal Capacity)

6-8 USD Mn
(Investment Estimate)

6,000-7,000 Sq. Mts
(Land Requirement)

4-6 USD Mn
(Net GDP Contribution from Operations)

80-100
(Potential Employment Impact)

15%-25%
(IRR)

Direct Investment Model, Joint venture
(Ideal Investment Model)

Scalability & Localization

- Saudi Arabia has the largest integrated aluminium business in the region, which helps in easy procurement of raw materials for production
- Primary and semi-finished Aluminium products are available in the kingdom at competitive prices. This in turn establishes a solid foundation for developing high value-added Aluminium products for various end-use sectors

HSE Implications

Risks from High Temperature Environment

Melting processes are typically handled at higher temperatures. Any contact with molten Aluminium could cause serious hazard

Aluminium Composite Panels

Application Perspective

Opportunity Overview

Aluminium composite panel (ACP) is a flat panel that consists of two thinly coated aluminium sheets bonded to a non-aluminium core.

ACP is more flexible and can be converted in any shape easily. ACPs have properties such as lower thickness, high insulation, and superior sealing that is crucial for building structures.

End-Use Applications

Due to the strength, flexibility, and high durability ACP are majorly used in following areas:

- Building Cladding or Façade material, insulation, home interiors, and partitions. ACPs also has several uses in the automotive sector including body paneling

Feedstock Requirement

- Aluminium sheet
- Polyethylene core (polyethylene, and clinker polyethylene.)

Market Sizing

Global Aluminium composite panels market has been estimated at ~$6.2 billion in 2020 and is expected to reach ~$8.5 billion by 2025, with a CAGR between 6-6.5%. In terms of volume, global consumption of Aluminium composite panels is estimated at ~2.5 million tons in 2020 and is expected to reach ~3.6 million tons by 2025. Construction sector accounts for approximately 60% of the global demand.

ME&A Regional Demand —

~246,000 tons as of 2020.

Global Aluminium Composite Panel Demand

Key Countries Consuming

APAC region is the fastest growing in terms of demand for composite panels. The region accounts for ~40% of the global aluminium composite panels market. China is currently the world's largest producer, consumer and exporter of aluminium composite panels. China's position in the global market is backed by its growing building & construction industry.

Business Perspective

Plant Level Estimates

15.0-20.0 Ktpa
(Ideal Capacity)

20-25 USD Mn
(Investment Estimate)

10,000-12,000 Sq. Mts
(Land Requirement)

7-10 USD Mn
(Net GDP Contribution from Operations)

150-180
(Potential Employment Impact)

25%-30%
(IRR)

Direct Investment Model, Joint venture
(Ideal Investment Model)

Scalability & Localization

Few attractive factors for investments in Aluminium composite panels in Saudi Arabia are

- End-to-end logistics connectivity from raw material procurement to end-product export exists in KSA to support investment development
- KSA's initiatives to increase infrastructure and construction development

HSE Implications

Fire Safety Measures

ACP Manufacturing units must have class D fire extinguishing agents to be used on dusts, fines or molten metal. Coarse water to be sprayed on chips and turnings.

Aluminium Extrusions

Application Perspective

Opportunity Overview

Aluminium extrusions are elongated products, formed when an Aluminium alloy is forced through a die with a specific shape and retains the similar shape when it comes out. Extrusions can be made in 3 main categories - solid, hollow and semi-hollow. Increasing urbanization resulting in growing demand for investments in construction, communications, transportation and other related infrastructure is the major factor driving the growth of Aluminium extrusions.

End-Use Applications

Aluminium extrusions are widely used in Building & Construction sector in the MENA region. Apart from this, they also find uses electronics and telecommunications, automotive, energy, machinery and consumer goods

Feedstock Requirement

- Aluminium billet, generally in a solid cylindrical shape

Market Sizing

Global Aluminium extrusions market has been estimated at ~$63 billion in 2020 and is expected to reach ~$78 billion by 2025, with a CAGR between 4-5%. In terms of volume, global consumption of Aluminium extrusion materials is estimated at ~31 million tons in 2020 and is expected to reach ~39 million tons by 2025. Construction sector accounts for approximately 60% of the global demand.

Middle East Regional Demand —

~550,000 tons as of 2020.

Global Aluminium Extrusions Demand

Key Countries Supplying

China supplies more than 50% of the global Aluminium extrusions. China is also the largest consumer of extruded products in the world. China's supply is backed by more local availability of feedstock, number of manufacturing units and many larger scale plants, compared to other countries. Increase in industrial consumption of extruded products is driving the market in China and APAC.

Business Perspective

Plant Level Estimates

20.0-30.0 Ktpa
(Ideal Capacity)

20-25 USD Mn
(Investment Estimate)

15,000-20,000 Sq. Mts
(Land Requirement)

12-18 USD Mn
(Net GDP Contribution from Operations)

120-150
(Potential Employment Impact)

20%-30%
(IRR)

Direct Investment Model, Joint venture
(Ideal Investment Model)

Scalability & Localization

Few attractive factors for investments in Aluminium extrusion in Saudi Arabia are

- Raw Material Availability – Aluminium billets, the primary raw material for extrusion materials manufacturing is easily available in KSA
- KSA's initiatives to increase infrastructure and construction development

HSE Implications

Fire Hazard

Since most extrusion presses use mineral oil hydraulic systems at high pressures and temperatures, potential for fire is very high.

Aluminium Forgings

Application Perspective

Opportunity Overview

Aluminium forgings are made by pressing the metal in uniform blank shape between shaped or flat dies to produce high-strength parts. Forged aluminium materials are ideal for applications where lighter-weight metal is needed for speed or energy efficiency. They generally have high electrical and thermal conductivity and provides excellent corrosion resistance. They can be recycled indefinitely without losing its qualities.

End-Use Applications

Aluminium forgings are majorly used in machinery, aviation, automobiles, rail transport, marine, building and construction, sports and leisure industries

Feedstock Requirement

- Aluminium billets
- Most commonly used alloy grades in aluminium forgings include AL 6061, AL 6063, AL6082, AL 7075 etc.

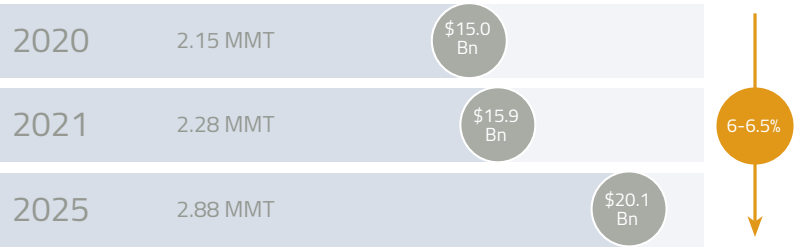
Market Sizing

Global Aluminium forgings market has been estimated at ~$11.2 billion in 2020 and is expected to reach ~$15 billion by 2025, with a CAGR of about 6-6.5%. In terms of volume, global consumption of Aluminium forged materials is estimated at ~2.2 million tons in 2020 and is expected to reach ~2.9 million tons by 2025. Increasing demand for lightweight and high-strength materials to be used in automotive and aerospace sectors are expected to drive the global market growth.

GCC Regional demand —

~215,000 tons as of 2020.

Global Aluminium Forgings Demand



Key Countries Supplying

Asia-Pacific accounts for major share of forged aluminium products supplied to the world. China alone accounts for considerable part of the forged aluminium products manufactured in the world. Emergence of the region as a key manufacturing hub for many industries and demand for infrastructure developments are the major factors behind growth of the market in Asia-Pacific.

Business Perspective

Plant Level Estimates

5.0-7.0 Ktpa
(Ideal Capacity)

20-25 USD Mn
(Investment Estimate)

8,000-10,000 Sq. Mts
(Land Requirement)

18-25 USD Mn
(Net GDP Contribution from Operations)

80-100
(Potential Employment Impact)

10%-15%
(IRR)

Direct Investment Model, Joint venture
(Ideal Investment Model)

Scalability & Localization

Few attractive factors for investments in Aluminium Forging in Saudi Arabia are

- Easy availability of primary raw material, Aluminium billet, in KSA
- Growing demand from manufacturing and construction sector

HSE Implications

Safe Operations

Each type of forging operation needs to be subjected to a risk assessment and should have a Safe Standard Operating Procedure (SSOP)

Aluminium Cables & Welding Wires

Application Perspective

Opportunity Overview

Aluminium welding wire is a slim metallic rod that is ignited to generate a heated arc for the purpose of fusing metal pieces together. Aluminium is corrosion resistive, wherein an oxide impermeable layer is formed. If damaged, the oxide layer can repair itself immediately.

End-Use Applications

Aluminium cables and welding wires are mostly used in Automotive & Transportation, military & commercial aircraft manufacturing, Ship building, Oil & gas, and appliance making industries

Feedstock Requirement

- Aluminium Rods/Ingots

Market Sizing

Global Aluminium cables and welding wire market has been estimated at ~$340-360 million in 2020 and is expected to reach ~$430-450 million by 2025, with a CAGR of about 4-5%. In terms of volume, global demand for aluminium cables and welding wires is estimated at ~160-170 Thousand metric tons in 2020 and is expected to reach ~200-210 Thousand metric tons by 2025. The market is driven by the increasing demand for lightweight vehicles, welding wires for repair and maintenance, and power infrastructure.

Middle East Regional Demand —

~6,000-8,000 tons as of 2020.

Global Aluminium Cables & Welding Wires Demand

Key Countries Supplying

APAC accounts for more than 50% share of aluminium cables and welding wire market. The growth in APAC region could be majorly attributed to enhancement in the transportation sector, along with the rise in automotive industry. China and Japan are the key markets. In terms of manufacturers, the market has high concentration and major manufacturers are concentrated in few top producing regions such as USA, China and Europe.

Business Perspective

Plant Level Estimates

6.0-8.0 Ktpa
(Ideal Capacity)

8-12 USD Mn
(Investment Estimate)

10,000-15,000 Sq. Mts
(Land Requirement)

7-10 USD Mn
(Net GDP Contribution from Operations)

40-60
(Potential Employment Impact)

20%-30%
(IRR)

Private Sector Model, Joint venture/Partnership
(Ideal Investment Model)

Scalability & Localization

Few attractive factors for investments in Aluminium cables and welding wires in Saudi Arabia are

- Robust logistics infrastructure availability, starting from raw material procurement to finished product export
- Increasing industrial activity and growing demand for welding consumables

HSE Implications

Dealing with Hot Metal

When molten metal is transferred from furnace, the temperatures will be high. Employees must be protected with modern molten metal splash wear clothing.

Aluminium Slugs/Circle

Application Perspective

Opportunity Overview

Slug is an aluminium sheet blank, cold pressed out of aluminium sheet coils in different shapes. They are made in different thickness and shapes such as circle, oval, rectangle, dome, and concave etc. The market for aluminium slugs is primarily driven by their increased usage in Healthcare, food & beverage, pharmaceuticals and other industries for having eco-friendly and recyclable properties.

End-Use Applications

Aluminium slugs are majorly used in manufacturing cookware and cooking utensils, lighting and lighting equipment, satellite dishes, automotive wheel rims, pontoon boats, and fuel tanks.

Feedstock Requirement

- Aluminium Ingot

Market Sizing

Global Aluminium slug market has been estimated at ~$3.5 billion in 2020 and is expected to reach ~$4.1 billion by 2025, with a CAGR of about 3-4%. In terms of volume, global supply of Aluminium slugs is estimated at ~1.3-1.4 million tons in 2020 and is expected to reach ~1.6-1.7 million tons by 2025. Increase in demand for smaller and convenient slugs for extrusion is driving the growth of the industry.

Middle East Regional Demand —

~12,000-14,000 tons as of 2020.

Global Aluminium Slugs/Circle Demand

Key Countries Consuming

Asia Pacific accounts for major share of the aluminium slugs market. Increased population and rapid urbanization resulting in increased use of aluminium sub-products in the region. Aluminium slugs recyclability and their growing use in beverages packaging, automotive and healthcare industries is the major reason driving the growth of slugs market in APAC.

Business Perspective

Plant Level Estimates

15.0-20.0 Ktpa
(Ideal Capacity)

20-25 USD Mn
(Investment Estimate)

10,000-15,000 Sq. Mts
(Land Requirement)

10-15 USD Mn
(Net GDP Contribution from Operations)

50-60
(Potential Employment Impact)

18%-22%
(IRR)

Private Sector Model,
Joint venture/Partnership
(Ideal Investment Model)

Scalability & Localization

Few attractive factors for investments in Aluminium Slugs in Saudi Arabia are

- Raw Material Availability – Aluminium ingot, the primary raw material for slugs manufacturing
- Potential demand from food and beverage industry which is the major end-use sector for slugs

Sustainability Implications

Global Warming Potential

Direct GHG emissions from an average aluminium slug production facility is estimated at 1,646.2 kg CO2eq/t of slugs. Manufacturers must investigate use of aluminium scrap instead of electrolysis aluminium, implementation of carbon capture and a mix of both to reduce environmental impact.

Aluminium Wheels & Castings

Application Perspective

Opportunity Overview

Aluminium wheels are formed from single block of metal by hot forging, followed by hot or cold spinning and the necessary machining operations. Currently, most aluminium wheels are produced by low-pressure die casting methods. They are made from a mix of aluminium, silica and other materials such as magnesium and titanium. It offers benefits such as better balance capability, light weight and corrosion resistance compared to steel frames, and prolongs the life of tires and break-pads.

End-Use Applications

- Passenger Vehicles
- Commercial Vehicles
- Motorcycles

Feedstock Requirement

- Molten Aluminium or ingots

Market Sizing

Global Aluminium alloy wheels and castings market is estimated at ~$17 billion in 2020 and is expected to reach ~$22 billion by 2025, with a CAGR of ~5%. In terms of volume, global demand for Aluminium alloy wheels and castings is estimated at ~140 million units in 2020 and is expected to reach ~180 million units by 2025. Increasing demand for light weight and fuel-efficient vehicles is the major factor driving the growth for aluminium wheels and castings.

KSA Demand —

~1,060 thousand units as of 2020.

Global Aluminium Wheels & Castings Demand

Key Countries Supplying

China supplies major share of the aluminium alloy wheels demand. Currently it accounts for ~40-50% of the global supply. China is also the largest consumer, with demand primarily driven by increased automotive manufacturing, especially EV and hybrid vehicles which requires light weight components.

Business Perspective

Plant Level Estimates

1.2-1.5 Mn Units/year **(Ideal Capacity)**
30-50 USD Mn **(Investment Estimate)**
10,000-12,000 Sq. Mts **(Land Requirement)**
50-70 USD Mn **(Net GDP Contribution from Operations)**
100-150 **(Potential Employment Impact)**
15%-20% **(IRR)**
Direct Investment Model, Joint venture **(Ideal Investment Model)**

Scalability & Localization

Few attractive factors for investments in Aluminium Wheels & Castings in Saudi Arabia are

- Easy raw Material Availability
- KSA's potential growth in automotive sector

HSE Implications

Risk with Moisture

Presence of moisture in molten metal or by pouring molten metal into containers with moisture could cause steam explosion

Chemical Explosion Risk

Introducing reactive chemical substances such as oxidizing agents into smelters or cubicles containing molten aluminium could cause gas pressure build up.

Aluminium Caps & Closures

Application Perspective

Opportunity Overview

Caps & Closures are the items which closes various items in a container. Aluminium caps & closures are used to seals the contents inside of a bottle, protecting those contents from dust, spilling, evaporation, and/or from the atmosphere.

End-Use Applications

Aluminium Caps & Closures commonly used for Beverage Packaging, Pharmaceutical Packaging, Food Packaging, Home & personal care products

Feedstock Requirement

- Aluminium Sheets

Market Sizing

Global Aluminium Caps & Closures market is estimated at ~$6.3 billion in 2020 and is expected to reach ~$8 billion by 2025, with a CAGR of ~5%. In terms of volume, global demand for Aluminium Caps & Closures is estimated at ~250 Billion units in 2020 and is expected to reach ~320 Billion units by 2025. Increase in demand for temperature resistant, alcohol resistant, and water-resistant closure materials in beverages, foods, and pharmaceuticals is driving the global Aluminium Caps & Closures market.

ME&A Demand —

~21 billion units as of 2020.

Global Aluminium Caps & Closures Demand

Key Countries Supplying

APAC dominates the global aluminium caps & closures market in terms of supply. Improved economic conditions and growth of the beverages industry and growing healthcare industry in the region coupled with government regulations is expected to enhance the growth of market. Developing countries such as China, India, and Brazil are poised to witness high demand because of consumer's preference towards packaged food products.

Business Perspective

Plant Level Estimates

100-150 Mn Units/year **(Ideal Capacity)**
3-4 USD Mn **(Investment Estimate)**
1,000-1,500 Sq. Mts **(Land Requirement)**
1.5-2.5 USD Mn **(Net GDP Contribution from Operations)**
15-30 **(Potential Employment Impact)**
20%-30% **(IRR)**
Direct Investment Model, Joint venture **(Ideal Investment Model)**

Scalability & Localization

Few attractive factors for investments in Aluminium Caps & Closures in Saudi Arabia are

- Primary Raw Material Availability
- KSA's potential growth in F&B and Pharmaceuticals industry

HSE Implications

Health & Safety Concerns

Aluminium caps and closures are not inert to food, hence should be coated with protective lacquers to prevent metal–food interaction and migration of metal components.

Aluminium Conductors

Application Perspective

Opportunity Overview

Aluminium conductors are made of one or more strands of aluminium wire depending on the application. Any of several aluminium alloys employed for conducting electric current; because its weight is one-half that of copper for the same conductance.

End-Use Applications

Aluminium conductors are typically used in power lines and grids in various industries - oil & gas, mining, chemicals, utilities, infrastructure etc.

Feedstock Requirement

- Aluminium Wire rod

Market Sizing

Global Aluminium Conductors market is estimated at ~$6.8 billion in 2020 and is expected to reach ~$7.3 billion by 2025, with a CAGR of ~1-2%. In terms of volume, global demand for Aluminium Conductors is estimated at ~5.2 Mt in 2020 and is expected to reach ~5.6 Mt by 2025. Rising electrification rate in developing economies is a key driver for the aluminium conductor market.

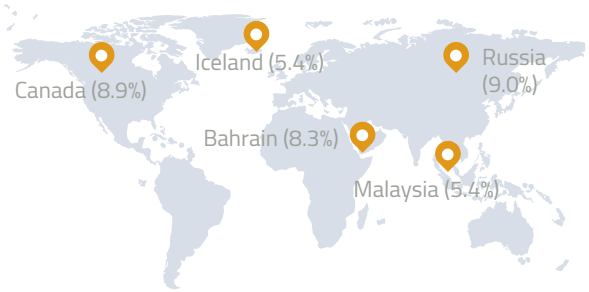
ME Demand —

~110,000 tons as of 2020.

Global Aluminium Conductors Demand

Key Countries Supplying

Asia-Pacific is the major region in terms of supply of aluminium conductors. Backed by vast feedstock availability and manufacturing facilities, the region accounts for more than 50% of the global supply. China, Japan, India are the major countries in the region which contributes to major share of the supply. The region is followed by Europe and North America.



Business Perspective

Plant Level Estimates

40-60 Ktpa
(Ideal Capacity)

20-25 USD Mn
(Investment Estimate)

8,000-12,000 Sq. Mts
(Land Requirement)

12-18 USD Mn
(Net GDP Contribution from Operations)

40-50
(Potential Employment Impact)

20%-25%
(IRR)

Direct Investment Model, Joint venture
(Ideal Investment Model)

Scalability & Localization

Few attractive factors for investments in Aluminium Conductors in Saudi Arabia are

- Primary Raw Material Availability
- Potential demand from utilities and infrastructure development sectors

HSE Implications

Corona and RI Performance

Sharp edges and scratches should be avoided on the conductors. Surface must be smooth, clean, without cuts and abrasions

Aluminium Sulphate

Application Perspective

Opportunity Overview

Aluminium Sulphate, also called as alum, appears in white crystalline solid, with a sweet taste. It can also be obtained in powder state.18H2O. Both these forms are soluble in water, non-combustible, and nontoxic.

End-Use Applications

Primary uses of Aluminium sulphate are in Paper sizing and water treatment. It also finds applications in various other miscellaneous uses in petrochemical industries, dyestuffs, food and pharmaceuticals.

Feedstock Requirement

- Bauxite
- Sulfuric Acid
- Barium Sulphide

Market Sizing

Global Aluminium Sulphate market is estimated at ~$1.2 billion in 2020 and is expected to reach ~$1.6 billion by 2025, with a CAGR of ~6%. In terms of volume, global demand for Aluminium Sulphate is estimated at ~8 Mt in 2020 and is expected to reach ~10.7 Mt by 2025. Increasing uses of aluminium sulphate in water purification and water treatment fueling the growth of global aluminium sulphate market.

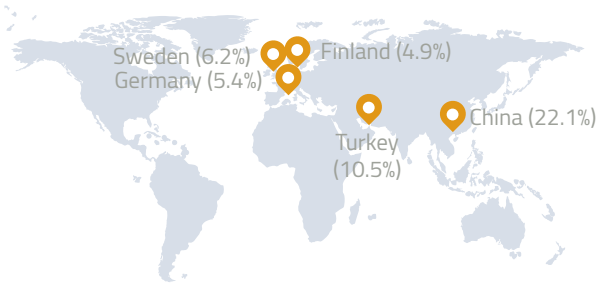
ME&A Demand —

~0.88 million tons as of 2020.

Global Aluminium Sulphate Demand

Key Countries Supplying

APAC is the major region in terms of supply and exports. The region contributes to around 45% of the global exports. This is followed by Europe, which contributes to ~40% of the global exports. In terms of countries, China is the major supplier which accounts for ~22% of the global exports



Business Perspective

Plant Level Estimates

100-150 Ktpa **(Ideal Capacity)**
6-8 USD Mn **(Investment Estimate)**
6,000-8,000 Sq. Mts **(Land Requirement)**
2-3 USD Mn **(Net GDP Contribution from Operations)**
20-30 **(Potential Employment Impact)**
25%-30% **(IRR)**
Direct Investment Model, Joint venture **(Ideal Investment Model)**

Scalability & Localization

Few attractive factors for investments in Aluminium Sulphate in Saudi Arabia are

- Primary Raw Material Availability
- Potential demand for water treatment solutions

Sustainability Implications

Environment Hazard

The primary hazard with Aluminium sulphate is the threat to environment. Any Spillages on soil will be difficult to clean. Because of its acidity, Aluminium sulphate contaminates areas for wildlife and vegetation.

Aluminium tubes/pipes

Application Perspective

Opportunity Overview

Aluminium Tubes & Pipe is an extruded material. They have high corrosion resistance and medium strength. It is usually described as structural alloy, widely used for all types of industrial projects where lightweight and corrosion resistance are the primary concern.

End-Use Applications

Aluminium pipes are widely used in Oil & Gas Drilling, Automobile, Marine, Aerospace, Electrical appliances, Agriculture etc.

Feedstock Requirement

- Aluminium Alloy

Market Sizing

Global Aluminium tubes/pipes market is estimated at ~$4.4 billion in 2020 and is expected to reach ~$5.7 billion by 2025, with a CAGR of ~5-5.5%. In terms of volume, global demand for Aluminium tubes/pipes is estimated at ~1.7 Mt in 2020 and is expected to reach ~2.2 Mt by 2025.

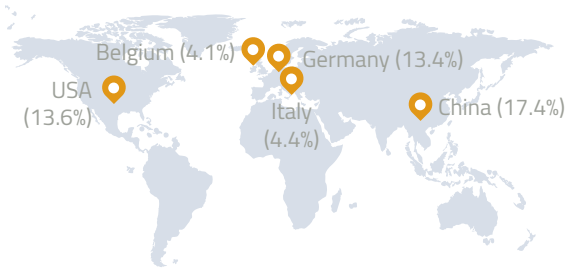
ME&A Demand —

~136,000 tons as of 2020.

Global Aluminium tubes/pipes Demand

Key Countries Supplying

Europe and APAC are the largest regions in terms of exports of aluminium pipes. The regions together account for ~80% of the global exports, followed by North America at ~15%. China and the US are the major countries in terms of exports, accounting for nearly 30% of the global exports.



Top Exporters*
Represents % Share of Global Aluminium Pipes Exports

Business Perspective

Plant Level Estimates

40-60 Ktpa
(Ideal Capacity)

50-75 USD Mn
(Investment Estimate)

10,000-15,000 Sq. Mts
(Land Requirement)

25-40 USD Mn
(Net GDP Contribution from Operations)

60-80
(Potential Employment Impact)

10%-15%
(IRR)

Direct Investment Model, Joint venture
(Ideal Investment Model)

Scalability & Localization

Few attractive factors for investments in Aluminium tubes/pipes in Saudi Arabia are

- Primary Raw Material Availability
- Increasing potential demand from end-use sectors

Sustainability Implications

Fire Hazard

As most of the extrusion presses use mineral oil hydraulic systems at high pressures temperatures, potential for fire around extrusion presses is very high

Poly-aluminium chloride (PAC)

Application Perspective

Opportunity Overview

Poly-aluminium chloride or "PAC" refers to a class of soluble aluminium products in which aluminium chloride has been partly reacted with base. It is manufactured both in liquid and powder form. Typically, yellow in color, PAC is classified as corrosive at high concentrations. PAC is mixable with water at all concentrations, some dilute solutions hydrolyze to precipitate Aluminium Hydroxide

End-Use Applications

- PAC is widely used in water treatment applications, in purification of drinking / potable water, wastewater treatment etc.
- Apart from these, PAC also finds uses in pulp and paper industry, deodorants and antiperspirants

Feedstock Requirement

- Aluminium Hydroxide
- Calcium aluminate powder
- Hydrochloric acid

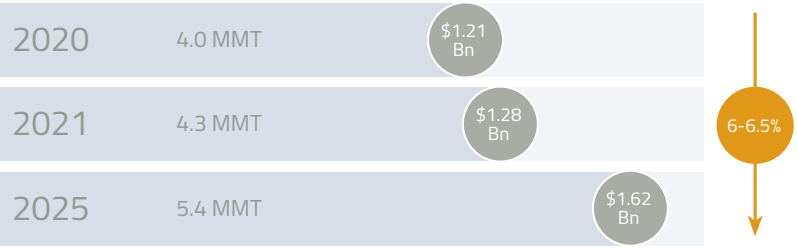
Market Sizing

Global Poly-aluminium chloride market is estimated at ~$1.2 billion in 2020 and is expected to reach ~$1.6 billion by 2025, with a CAGR of ~6%. In terms of volume, global demand for Poly-aluminium chloride is estimated at ~4 MMt in 2020 and is expected to reach ~5.4 MMt by 2025. The water treatment sector is anticipated to be the high-growth segment for the poly aluminium chloride market during the forecast period

ME&A Demand —

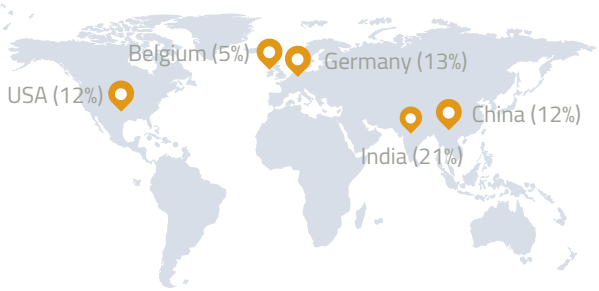
~400,000 tons as of 2020.

Global Poly-Aluminium Chloride Demand



Key Countries Supplying

As of 2019, Asia-Pacific serves the maximum demand for PAC. China is the major country in the region in terms of supply. Southeast Asia plays an important role in terms of demand, which is mostly in liquid form, dominated by Japan and Korea



Business Perspective

Plant Level Estimates

20-40 Ktpa
(Ideal Capacity)

8-12 USD Mn
(Investment Estimate)

20,000-25,000 Sq. Mts
(Land Requirement)

3-6 USD Mn
(Net GDP Contribution from Operations)

30-40
(Potential Employment Impact)

10%-15%
(IRR)

Direct Investment Model, Joint venture
(Ideal Investment Model)

Scalability & Localization

Attractive factors for investments in Poly-aluminium chloride (PAC) in Saudi Arabia are

- Potential growth in water treatment chemicals owing to growth in industrial activity across the Middle East and regulations for water & water treatment

Sustainability Implications

Decomposition Hazard

In case of thermal decomposition or fire accident, it may generate toxic and/or hazardous gases such as hydrogen chloride, CL2, and aluminium oxides

Aluminium Alloy Drill Pipe

Application Perspective

Opportunity Overview

The aluminum alloy drill pipes are light weight, has high specific strength, and can be operated at deep drilling depth. They are typically 27 to 45 feet in length. Application of aluminium alloy drill rod has a great practical significance for improving geological drilling efficiency, promoting scientific drilling technological progress and reducing the energy consumption.

End-Use Applications

Aluminium alloy drill pipes are majorly preferred for Extended Reach Drilling applications (ERD) especially in deep water

Feedstock Requirement

- Aluminium Billets

Market Sizing

As of 2020, global aluminium alloy drill pipe market is expected to witness a growth rate of ~4-5% between 2021-2025. Rising demand in the oil & gas exploration activities, coupled with water and other natural resources extraction which requires a wide range of essential tools and equipment such as pipes, collars and others are the major factors driving the demand for Aluminium alloy drill pipe.

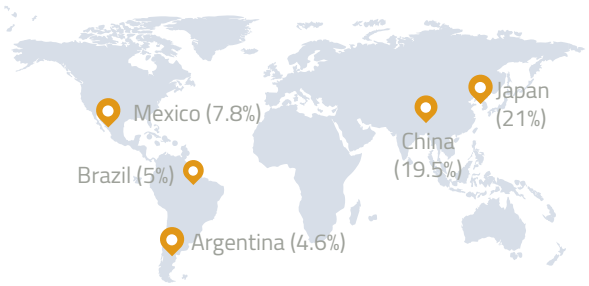
ME Regional Demand —

~52,000 tons as of 2020.

Global Aluminium Alloy Drill Pipe Demand

Key Countries Supplying

China is the largest supplier of aluminium alloy drill pipes. The country is also the 2nd largest market in terms of demand, just behind the US. These two countries account for more than 50% of the global market demand. China's dominance can be attributed to vast aluminium resources and local manufacturing units.



Business Perspective

Plant Level Estimates

5.0-10.0 Ktpa
(Ideal Capacity)

15-20 USD Mn
(Investment Estimate)

20,000-30,000 Sq. Mts
(Land Requirement)

5-10 USD Mn
(Net GDP Contribution from Operations)

100-120
(Potential Employment Impact)

5%-10%
(IRR)

Direct Investment Model, Joint venture
(Ideal Investment Model)

Scalability & Localization

Few attractive factors for investments in Aluminium Alloy Drill Pipe in Saudi Arabia are

- Primary Raw Material Availability
- Potential demand from oil & gas sector

HSE Implications

Operational Hazards

Aluminium drill pipes are susceptible to some issues while operating at high temperatures, the decreased weight reduces the burst strength and buckling loads of the drill pipe resulting in operational hazards.

Aluminium Blinds and Shades

Application Perspective

Opportunity Overview

Aluminium blinds and shades are typically window covering materials, made up of several long horizontal or vertical slats of various sizes. These slats will be held together by the chords that run through. They are of two types ready-made blinds and made-to-measure blinds. Ready made blinds are manufactured in set sizes and can be cut down according to the requirement. made-to-measure blinds are made to fit a given or measured window size.

End-Use Applications

Aluminium blinds and shades can be used in residential, commercial, retail, hospitality, health care and educational institutions etc.

Feedstock Requirement

- Aluminium Sheets

Market Sizing

As of 2020, global aluminium blinds and shades market is expected to witness a growth rate of ~4-5% between 2021-2025. Increase in construction activities in residential and non-residential sectors and the rise in the urbanization and industrialization in the developing countries are the major factors for the growth of the blinds and shades market.

ME Regional Demand —

~71,500 tons as of 2020.

Global Aluminium Blinds and Shades Demand

Key Countries Supplying

North America dominates the blinds and shades market due to the different varieties of the product availability in the market. In terms of growth, Asia-Pacific is projected to lead the market due to the increase in the population and increase in construction activity.

Business Perspective

Plant Level Estimates

20.0-30.0 Ktpa
(Ideal Capacity)

6-8 USD Mn
(Investment Estimate)

4,000-6,000 Sq. Mts
(Land Requirement)

13-20 USD Mn
(Net GDP Contribution from Operations)

20-30
(Potential Employment Impact)

15%-20%
(IRR)

Direct Investment Model, Joint venture
(Ideal Investment Model)

Scalability & Localization

Few attractive factors for investments in Aluminium Blinds & Shades in Saudi Arabia are

- Primary Raw Material Availability
- Potential growth in construction activity, which in turn helps the blinds & shades demand growth

HSE Implications

Fire Hazard

Since most presses use mineral oil hydraulic systems at high pressures temperatures, potential for fire around work area is very high

Aluminium Notch Bars

Application Perspective

Opportunity Overview

The Aluminum notch bar is a type of primary aluminum that is produced after casting or reduction process from Alumina. They are required for removal of surface defects and oxidation skin. They have low melting point and are corrosion proof

End-Use Applications

Major end-use applications of aluminium notch bars are in Casting process, as de-oxidizer in Steel & Foundry industries. They also find applications in Marine and Automobile, Construction, Machine & Equipment industries

Feedstock Requirement

- Commercial grade aluminium of 99% purity/ Aluminium Ingots

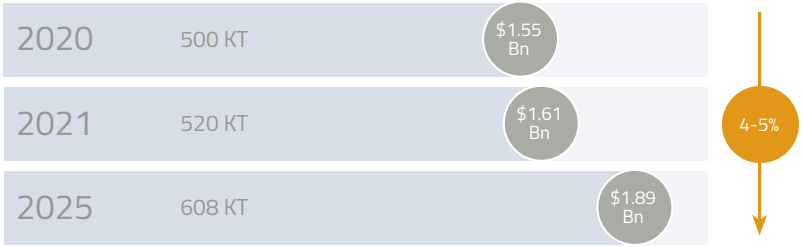
Market Sizing

As of 2020, global aluminium notch bars market is expected to witness a growth rate of ~4% between 2021-2025. Growing infrastructure initiatives, reorganization of urban centers are expected to drive the demand for steel making, which in turn is expected to drive the global market of Aluminium Notch bars.

ME Regional Demand —

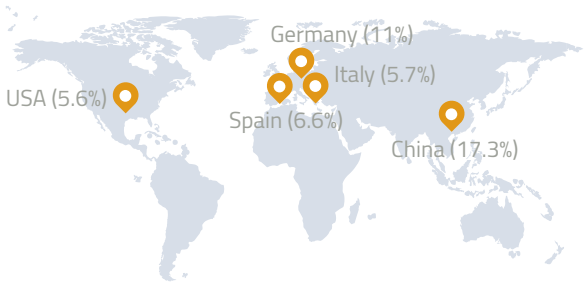
~15,000 tons as of 2020.

Global Aluminium Notch Bars Demand



Key Countries Supplying

China is the largest country in terms of Aluminium Notch bars supply. The country's dominance can be attributed to availability of abundant Aluminium resources and local manufacturing facilities. Asia-Pacific leads the overall global market in terms of regional supply, as the region's steel making industry is the largest in the world.



Top Exporters
% Share of Global Aluminium Bar Exports

Business Perspective

Plant Level Estimates

3-6 Ktpa
(Ideal Capacity)

4-5 USD Mn
(Investment Estimate)

6,000-8,000 Sq. Mts
(Land Requirement)

1-2 USD Mn
(Net GDP Contribution from Operations)

20-30
(Potential Employment Impact)

10%-15%
(IRR)

Direct Investment Model, Joint venture
(Ideal Investment Model)

Scalability & Localization

Few attractive factors for investments in Aluminium Notch bars in Saudi Arabia are

- Primary Raw Material Availability

HSE Implications

Melting Process Safety

Melting process should be carried out under protective cover flux to avoid excessive melting bases

Phosphate

- Aluminium Fluoride
- Sulfuric Acid
- Technical Grade Ammonium Nitrate
- Ammonium Sulfate
- Dicalcium Phosphate
- Phosphorus Trichloride
- Fertilizer Grade Ammonium Nitrate
- Monocalcium Phosphate (MCP)
- Silicon Dioxide
- Crystalline MAP
- Monopotassium Phosphate (MKP)
- Sodium Fluorosilicate
- Low-Carbon Cement Clinker
- Monosodium Phosphate (MSP)

Aluminium Fluoride

Application Perspective

Opportunity Overview

Aluminium fluoride is odorless in nature and appears as white powder or granules. It is generally denser than water and resists the action of even the strong solvents, such as sulfuric acid.

End-Use Applications

Aluminium fluoride is primarily used as a flux in production of primary aluminium. Apart from this, Aluminium fluoride also finds uses in Alcohol Production, Metal Welding, Ceramics, Non-ferrous industry and Fluoroaluminate glasses.

Feedstock Requirement

- Hydro-fluorosilicic acid
- Alumina hydrate

Market Sizing

Global aluminium fluoride market is estimated at ~$1.4 billion in 2020 and is expected to reach ~$1.6 billion by 2025, with a CAGR of ~1.5%. In terms of volume, global demand for aluminium fluoride is estimated at ~1.2 Mt in 2020 and is expected to reach ~1.3 Mt by 2025. Rapid urbanization and industrial development are encouraging growing usage of aluminium in construction activities, which in turn acting as the major demand driver for aluminium fluoride growth as well.

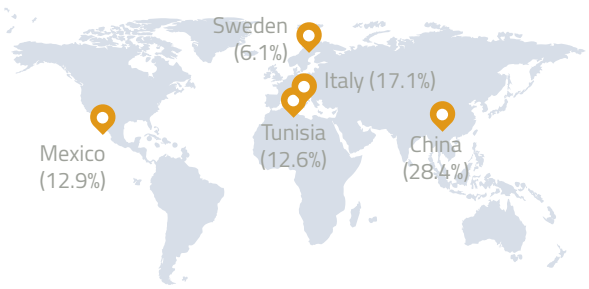
GCC Regional Demand —

~108,000 tons as of 2020.

Global Aluminium Fluoride Demand

Key Countries Supplying

Aluminium producers (smelters) are the major consumers of Aluminium Fluoride. China dominates Aluminium Fluoride market, strongly supported by raw material availability. China remains the largest exporter, supplying close to 100 Kt to export markets in 2019. The other major regions such as EU and North America's remains largely intra-regional.



Business Perspective

Plant Level Estimates

10.0-20.0 Ktpa
(Ideal Capacity)

30-40 USD Mn
(Investment Estimate)

30,000-40,000 Sq. Mts
(Land Requirement)

5-10 USD Mn
(Net GDP Contribution from Operations)

65-80
(Potential Employment Impact)

25%-30%
(IRR)

Direct Investment Model, Joint venture
(Ideal Investment Model)

Scalability & Localization

Few attractive factors for investments in aluminium fluoride in Saudi Arabia are

- Raw Material Availability
- Growing demand for Aluminium in the Middle East from construction segment

Sustainability Implications

Waste Generated

1 ton of Aluminium fluoride production generates ~3 tons of waste, ~60% of this waste is contaminated with Fluorine ions

Sulfuric Acid

Application Perspective

Opportunity Overview

Sulfuric acid (H_2SO_4), also called oil of vitriol, or hydrogen sulfate. It is prepared by the reaction of water with sulfur trioxide, which in turn is made by chemical combination of sulfur dioxide and oxygen. Sulfuric acid is very reactive and dissolves most metals, it is a concentrated acid that oxidizes, dehydrates, or sulfonates most organic compounds. Sulfuric acid is not combustible, but it is a strong oxidizer that enhances the combustion of other substances, does not burn itself.

End-Use Applications

Sulfuric acid is used in the manufacture of fertilizers, pigments, dyes, drugs, explosives, detergents, and inorganic salts and acids, as well as in petroleum refining and metallurgical processes.

Feedstock Requirement

- Dry sulfur dioxide (SO_2) and Water.

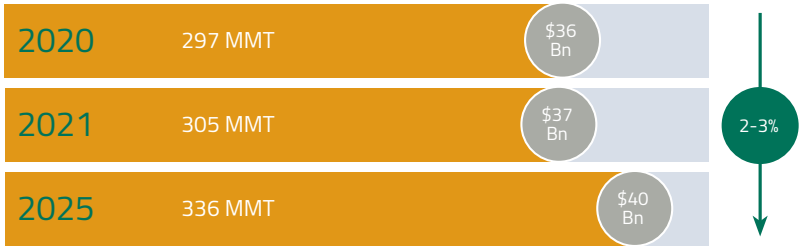
Market Sizing

Global Sulfuric acid market is estimated at ~$35 billion in 2020 and is expected to reach ~$40 billion by 2025, with a CAGR of ~2-3%. In terms of volume, global demand for Sulfuric acid is estimated at ~290 Mt in 2020 and is expected to reach ~340 Mt by 2025. Increase in the production of nutrient rich food crops and steady demand for the product from fertilizers, chemical manufacturing, paper & pulp, petroleum refinery, metal processing, and automotive industries are the major factors which are expected to drive the growth.

Middle East Regional Demand —

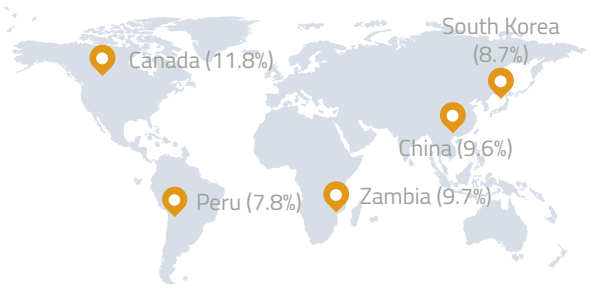
~12 million tons as of 2020.

Global Sulfuric Acid Demand



Key Countries Supplying

Asia-Pacific dominates the Sulphuric acid market, owing to the increasing demand from end-use industries such as chemicals, agriculture and textiles etc. North America is projected to see significant amount of growth in the sulfuric acid market due to the increasing growth in the manufacturing of fertilizers.



Business Perspective

Plant Level Estimates

1.5-2.5 Mtpa
(Ideal Capacity)

400-500 USD Mn
(Investment Estimate)

12,000-15,000 Sq. Mts
(Land Requirement)

150-200 USD Mn
(Net GDP Contribution from Operations)

50-80
(Potential Employment Impact)

25%-35%
(IRR)

Direct Investment Model, Joint venture
(Ideal Investment Model)

Scalability & Localization

Few attractive factors for investments in Sulfuric Acid in Saudi Arabia are

- Raw Material Availability
- Growing demand for fertilizers and related products

Sustainability Implications

Waste Generated

Production of sulfuric acid could result in significant waste of thermal energy associated with acid cooling by sea water, to an extent of 30 MW for 1500 ton/d production

Technical Grade Ammonium Nitrate

Application Perspective

Opportunity Overview

Ammonium nitrate, (NH4NO3), a salt of ammonia and nitric acid, used widely in fertilizers and explosives. The technical grade ammonium nitrate is colorless and crystalline in nature and contains about 33.5 percent nitrogen. Technical grade ammonium nitrate prills are specifically designed to be used as a solid oxidizer ingredient for explosive compositions.

End-Use Applications

Technical Grade Ammonium Nitrate is extensively used as key raw material for manufacturing explosives. Apart from this, it is also used in fertilizer manufacturing.

Feedstock Requirement

- Ammonia
- Nitric acid

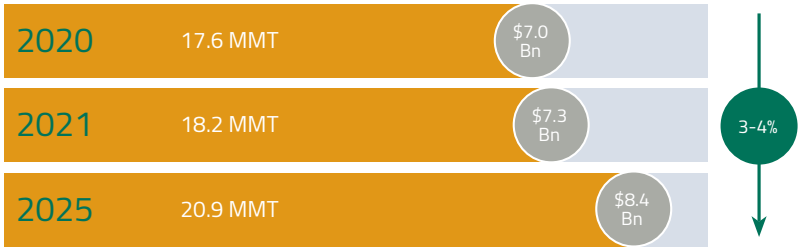
Market Sizing

Global Technical ammonium nitrate market is estimated at ~$7 billion in 2020 and is expected to reach ~$8.5 billion by 2025, with a CAGR of ~3-4%. In terms of volume, global demand for Technical ammonium nitrate is estimated at ~17.6 Mt in 2020 and is expected to reach ~21 Mt by 2025. mining/material extraction industries that require the removal of large volumes of material are the major growth enablers for TAN demand. Coal mining is the largest individual consumer, representing 35% of global demand.

Middle East Regional Demand —

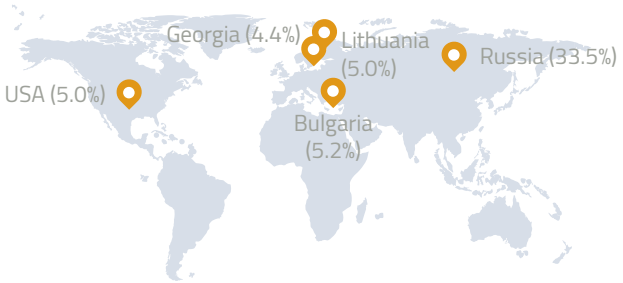
~700,000 tons as of 2020

Global Technical Ammonium Nitrate Demand



Key Countries Supplying

Russia is the largest exporter with one-third share of global exports followed by Bulgaria and Lithuania. Eastern Europe, Western Europe, and the United States are the leading consumers of ammonium nitrates. In 2019, these three regions together accounted for about 53% of total world consumption.



Business Perspective

Plant Level Estimates

250-350 Ktpa
(Ideal Capacity)

300-400 USD Mn
(Investment Estimate)

15-25 Acres
(Land Requirement)

25-50 USD Mn
(Net GDP Contribution from Operations)

80-100
(Potential Employment Impact)

5%-15%
(IRR)

Direct Investment Model, Joint venture
(Ideal Investment Model)

Scalability & Localization

Few attractive factors for investments in ammonium nitrate in Saudi Arabia are

- Raw Material Availability i.e., Ammonia and Nitric acid
- Increasing demand from mining sector

Sustainability Implications

Emissions of Particulate Matter

Production of Ammonium Nitrate results in emissions of Particulate matter, ammonia and nitric acid. Total Quantities of Nitrogen discharge will be ~0.01-18.4 Kg/t of product

Ammonium Sulfate

Application Perspective

Opportunity Overview

Ammonium sulfate is an inorganic sulfate salt, which is generally 21% Nitrogen and 24% sulfur. Ammonium Sulfate is obtained by reaction of sulfuric acid with 2 equivalents of ammonia. It is white and odorless solid in nature and dissolves in water.

End-Use Applications

Ammonium sulfate finds its major use as Fertilizer for alkaline soils. Apart from this, Ammonium sulfate is used in water treatment, wood preservative and flame retardant etc.

Feedstock Requirement

- Sulfuric Acid
- Ammonia

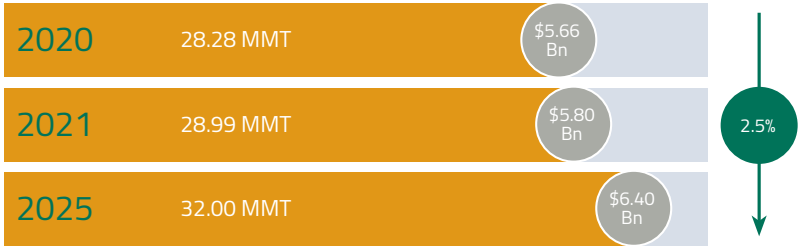
Market Sizing

Global Ammonium sulfate market is estimated at ~$5.6 billion in 2020 and is expected to reach ~$6.4 billion by 2025, with a CAGR of ~2.5%. In terms of volume, global demand for Ammonium sulfate is estimated at ~28.3 Mt in 2020 and is expected to reach ~32 Mt by 2025. Increase in the consumption of the ammonium sulfate as a soil fertilizer is the major factor driving the global market.

Middle East Regional Demand —

~1.24 million tons as of 2020.

Global Ammonium Sulfate Demand



Key Countries Supplying

Ammonium sulfate production capacity has wide geographic diversification, with supply is spread across regions. Major share of supply is handled by the USA, Russia and few countries in Southeast Asia. Increased population and rising consumption of agricultural products is major factor influencing the growth of Ammonium sulfate consumption across these countries.

Business Perspective

Plant Level Estimates

150.0-250.0 Ktpa
(Ideal Capacity)

10-15 USD Mn
(Investment Estimate)

2,500-3,000 Sq. Mts
(Land Requirement)

5-10 USD Mn
(Net GDP Contribution from Operations)

40-60
(Potential Employment Impact)

25%-30%
(IRR)

Direct Investment Model, Joint venture
(Ideal Investment Model)

Scalability & Localization

Few attractive factors for investments in ammonium sulfate in Saudi Arabia are

- Primary Raw Material Availability
- Potential future demand from Middle East

Sustainability Implications

Solid and Hazardous Waste Generation

Ammonium Sulfate production results in generation of Used oil as Hazardous waste

Dicalcium phosphate

Application Perspective

Opportunity Overview

Di-calcium Phosphate (also known as Dibasic Calcium Phosphate or calcium monohydrogen phosphate) is the dihydrate form of calcium phosphate. DCP is produced by neutralization of phosphoric acid and calcium hydroxide, which precipitates the dihydrate as a solid. It is available in three forms - dihydrate or mineral brushite, hemihydrate, and anhydrous or mineral monetite.

End-Use Applications

Di-calcium Phosphate is mainly used as a dietary supplement in dog treats, breakfast cereals and noodle products. It is also used in pharmaceutical industries as a tabulating agent and in toothpastes as a tartar agent. DCP also finds uses in poultry field and in limited dietary calcium supplements.

Feedstock Requirement

- Phosphoric Acid
- Calcium Hydroxide

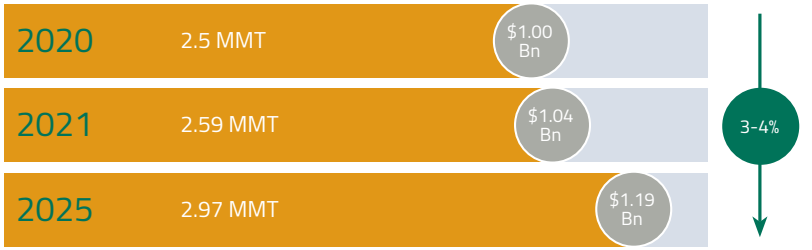
Market Sizing

Global Dicalcium phosphate market is estimated at ~$1.00 billion in 2020 and is expected to reach ~$1.2 billion by 2025, with a CAGR of ~3-4%. In terms of volume, global demand for Dicalcium phosphate is estimated at ~2.5 Mt in 2020 and is expected to reach ~3.0 Mt by 2025. Rising demand for dicalcium phosphate-based fertilizers and continuous developments in the agriculture segment is projected to fuel the demand for dicalcium phosphate.

Middle East Regional Demand —

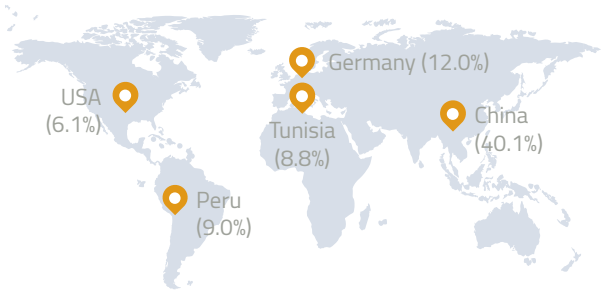
~100,000 tons as of 2020.

Global Dicalcium Phosphate Demand



Key Countries Exporting

Asia pacific dominates the Dicalcium market, owing to the growing awareness related to health and increasing demand for dietary products, and rising population. Increasing usage of dicalcium phosphate in the manufacturing of medicines and other health care products is another factor driving the market in APAC. China is the major country, owing to increasing population and rising demand for dietary food.



Business Perspective

Plant Level Estimates

50.0-100.0 Ktpa
(Ideal Capacity)

20-40 USD Mn
(Investment Estimate)

15-20 Thousand Sq. Mts
(Land Requirement)

10-15 USD Mn
(Net GDP Contribution from Operations)

50-70
(Potential Employment Impact)

20%-30%
(IRR)

Direct Investment Model, Joint venture
(Ideal Investment Model)

Scalability & Localization

Few attractive factors for investments in Dicalcium Phosphate in Saudi Arabia are

- Primary Raw Material Availability i.e., Phosphoric acid
- Potential demand from ME on the back of growth in fertilizers and animal feed production

Sustainability Implications

Water Management

Producing Dicalcium phosphate results in huge amounts of wastewater discharge and near similar amounts of product precipitate

Phosphorus Trichloride

Application Perspective

Opportunity Overview

Phosphorus trichloride is the most important of the three phosphorus chlorides. It is an important industrial chemical, being used for the manufacture of organophosphorus compounds for a wide variety of applications. It is a toxic and highly reactive reagent, which, on hydrolysis generates phosphorous acid and hydrochloric acid, exothermically.

End-Use Applications

Phosphorus trichloride is an important raw material for many of the organo phosphorus pesticides, dye intermediates and fire-retardant plasticizers.

Feedstock Requirement

- White phosphorus (P4)
- Chlorine

Market Sizing

Global Phosphorus trichloride market is estimated at ~$700 million in 2020 and is expected to reach ~$900 million by 2025, with a CAGR of ~5-6%. In terms of volume, global demand for Phosphorus trichloride is estimated at ~700 Kt in 2020 and is expected to reach ~900 Kt by 2025. Increasing demand for manufacturing commodity chemicals and agrochemicals is the major demand driver for Phosphorus trichloride market.

Middle East Regional Demand —

~14,000 tons as of 2020.

Global Phosphorus Trichloride Demand

Key Countries Supplying

Asia-Pacific dominates the Phosphorus Trichloride market, on the back of growing use in the manufacturing of fertilizers, insecticides, and pesticides in the region. APAC is also a leading phosphorus trichloride producer, with majority of the production concentrated in China. The other major region, North America's market is primarily driven by the high demand from chemical manufacturing industries.

Business Perspective

Plant Level Estimates

10-15 Ktpa
(Ideal Capacity)

10-20 USD Mn
(Investment Estimate)

5,000-7,000 Sq. Mts
(Land Requirement)

7-10 USD Mn
(Net GDP Contribution from Operations)

30-50
(Potential Employment Impact)

10%-20%
(IRR)

Direct Investment Model, Joint venture
(Ideal Investment Model)

Scalability & Localization

Few attractive factors for investments in Phosphorus Trichloride in Saudi Arabia are

- Primary Raw Material Availability
- Potential demand growth on account of increased demand for agrochemicals in the MENA region.

Sustainability Implications

Emissions of Toxic Fumes

PCl3 reacts violently with water, producing heat and toxic and corrosive fumes. When heated to decomposition, Phosphorus trichloride emits highly toxic fumes of chlorides and phosphorus oxides.

Fertilizer Grade Ammonium Nitrate

Application Perspective

Opportunity Overview

Fertilizer Grade Ammonium nitrate, (NH_4NO_3), a salt of ammonia and nitric acid, used widely in fertilizers and explosives. FFGAN contains 33-34% N and has high density of prills. Due to the high density of prills, FGAN doesn't retain additives required for commercial purposes.

End-Use Applications

Ammonium nitrate is used commonly in fertilizers; in pyro techniques, herbicides, and insecticides; and in the manufacture of nitrous oxide. It is also used as an absorbent for nitrogen oxides, an ingredient of freezing mixtures, an oxidizer in rocket propellants, and a nutrient for yeast and antibiotics.

Feedstock Requirement

- Ammonia
- Nitric acid

Market Sizing

Global Fertilizer AN market is estimated at ~$9.5 billion in 2020 and is expected to reach ~$11.3 billion by 2025, with a CAGR of ~3-4%. In terms of volume, global demand for Fertilizer AN is estimated at ~23.8 MMt in 2020 and is expected to reach ~28.3 MMt by 2025.

Middle East Regional Demand —

~950,000 tons as of 2020.

Global Fertilizer Grade Ammonium Nitrate Demand

Key Countries Supplying

Russia is the largest exporter with one-third share of global exports followed by Bulgaria and Lithuania. Eastern Europe, Western Europe, and the United States are the leading consumers of ammonium nitrates. In 2019, these three regions together accounted for about 53% of total world consumption.

Business Perspective

Plant Level Estimates

300-400 Ktpa
(Ideal Capacity)

250-300 USD Mn
(Investment Estimate)

20-25 Acres
(Land Requirement)

45-60 USD Mn
(Net GDP Contribution from Operations)

80-100
(Potential Employment Impact)

5%-15%
(IRR)

Direct Investment Model, Joint venture
(Ideal Investment Model)

Scalability & Localization

Few attractive factors for investments in FGAN in Saudi Arabia are

- Primary Raw Material Availability i.e., Ammonia and Nitric acid
- Increasing demand for nitrogen-based fertilizers in the MENA region

HSE Implications

Presence of Combustible Substances

FGAN Can be classified as division -1 oxidizer if it contains not more than 0.4% combustible substances

Monocalcium phosphate (MCP)

Application Perspective

Opportunity Overview

Monocalcium phosphate, or calcium dihydrogen phosphate is a leavening acid commonly found in baked goods. MCP is obtained by the reaction of phosphoric acid and a calcium compound such as calcium hydroxide, calcium carbonate, or a more basic calcium phosphate. It is an inorganic compound and existing in two forms monohydrate (MCP) and anhydrous product (AMCP).

End-Use Applications

- MCP food grade is used as an acid component in baking powder.
- Feed grade as a nutrition supplement of calcium and phosphorus in animal and poultry, and as a super phosphate fertilizer in agriculture

Feedstock Requirement

- Calcium Hydroxide
- Phosphoric Acid

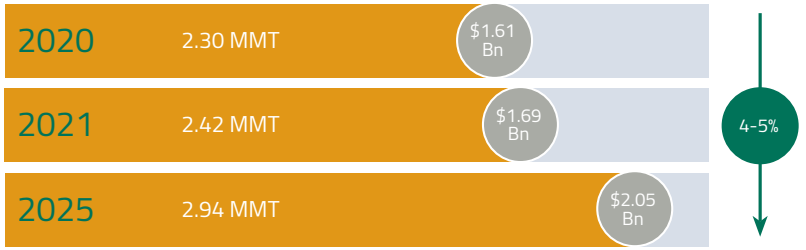
Market Sizing

Global Mono-calcium phosphate market is estimated at ~$1.6 billion in 2020 and is expected to reach ~$2.1 billion by 2025, with a CAGR of ~5%. In terms of volume, global demand for Mono-calcium phosphate is estimated at ~2.3 MMt in 2020 and is expected to reach ~2.9 MMt by 2025. Increase in the demand from the food and beverage industry and the demand from baked goods are the major factors driving the MCP market.

Middle East Regional Demand —

~115,000 tons as of 2020.

Global Monocalcium phosphate (MCP) Demand



Key Countries Supplying

Morocco is the largest exporter with more than one-third share of global exports followed by Jordan and Russia. Together these 3 countries account for more than 60% of the global exports. MCP's increasing use in animal feed and food & beverage industry is the major factor expected to drive the market.

Top Exporters*
% Share of Global Calcium Phosphate Exports

Business Perspective

Plant Level Estimates

60-80 Ktpa
(Ideal Capacity)

15-20 USD Mn
(Investment Estimate)

5,000-8,000 Sq. Mts
(Land Requirement)

5-10 USD Mn
(Net GDP Contribution from Operations)

30-40
(Potential Employment Impact)

20%-30%
(IRR)

Direct Investment Model, Joint venture
(Ideal Investment Model)

Scalability & Localization

Few attractive factors for investments in MCP in Saudi Arabia are

- Primary Raw Material Availability i.e., Phosphoric acid
- Potential future demand from Food & Beverage Industry in the Middle East

HSE Implications

Exposure to MCP Dust

MCP's effect on human organism is considered as hazardous, threshold limit value of monocalcium phosphate dust in workplace area is ~10 mg/m3

Silicon Dioxide

Application Perspective

Opportunity Overview

Silicon dioxide (SiO2), also known as silica, is a natural compound made of silicon (Si) and oxygen (O2) found mostly in sand, Silica has three main crystalline varieties: quartz, tridymite, and cristobalite.

End-Use Applications

- Silicon Dioxide is used in the construction industry to produce concrete, production of glass, production of elemental silicon
- It is also used as anti-caking agent in powdered foods like spices, pharmaceutical tablets, toothpaste to remove tooth plaque

Feedstock Requirement

- Silicon
- Oxygen

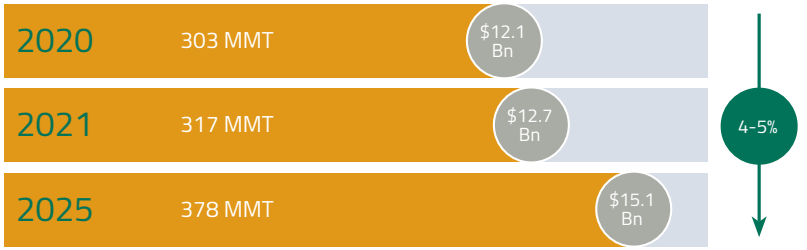
Market Sizing

Global Silicon dioxide market is estimated at ~$12 billion in 2020 and is expected to reach ~$15 billion by 2025, with a CAGR of ~4-5%. In terms of volume, global demand for Silicon dioxide is estimated at ~300 MMt in 2020 and is expected to reach ~380 MMt by 2025. Increase in demand for construction materials and rubber products are the major factor driving the silicon dioxide market.

Middle East Regional Demand —

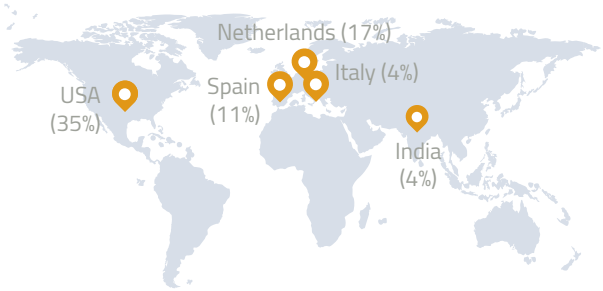
~6 million tons as of 2020.

Global Silicon Dioxide Demand



Key Countries Supplying

Silica market is heavily dominated by North America and Europe. These 2 regions together account for more than 60% of the global supply. US is the largest supplier which accounts for ~35% of the overall market



Business Perspective

Plant Level Estimates

10-20 Ktpa
(Ideal Capacity)

120-150 USD Mn
(Investment Estimate)

8-12 Thousand sq. mtrs
(Land Requirement)

25-50 USD Mn
(Net GDP Contribution from Operations)

40-60
(Potential Employment Impact)

15%-25%
(IRR)

Direct Investment Model, Joint venture
(Ideal Investment Model)

Scalability & Localization

Few attractive factors for investments in Silicon Dioxide in Saudi Arabia are

- Primary Raw Material Availability
- Potential growth in the Middle East's construction sector and therefore increase in demand for construction materials

HSE Implications

Health Hazard

The raw materials are processed at high temperatures (~1000 C), with varying degrees of conversion. This could result in workers being exposed to carcinogenic agents and increased risk of lung cancer

Crystalline MAP

Application Perspective

Opportunity Overview

Monoammonium phosphate (MAP) is a widely used source of phosphorus (P) and nitrogen (N). MAP is also known as ammonium phosphate monobasic and ammonium dihydrogen phosphate. It's water-soluble and dissolves rapidly in adequately moist soil. Upon dissolution, the two basic components of the fertilizer separate again to release ammonium (NH_4) and phosphate (H_2PO_4), both of which plants rely on for healthy, sustained growth.

End-Use Applications

- MAP is used in fertilizer, dry fire extinguishers, food additives, and for growing piezoelectric crystals for electronics and birefringent crystals for optics.

Feedstock Requirement

- Phosphoric acid
- Ammonia

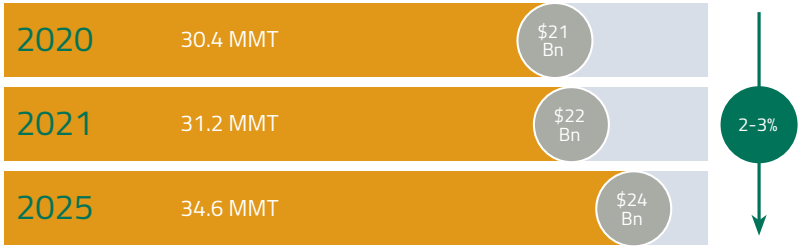
Market Sizing

Global Mono-Ammonium phosphate market is estimated at ~$21 billion in 2020 and is expected to reach ~$24 billion by 2025, with a CAGR of ~2.5%. In terms of volume, global demand for Mono-Ammonium phosphate is estimated at ~30 MMt in 2020 and is expected to reach ~35 MMt by 2025. Increase in the demands from agri-based industries and water treatment application are the major factors driving the MAP market.

Middle East Regional Demand —

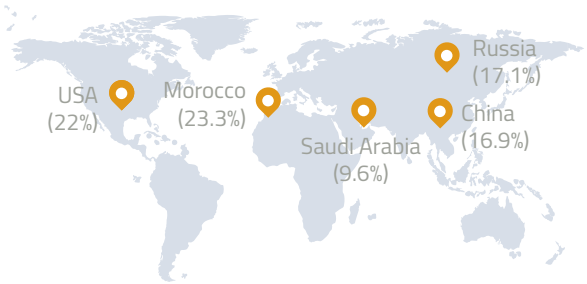
~910,000 tons as of 2020.

Global Crystalline Mono-Ammonium Phosphate (cMAP) Demand



Key Countries Supplying

Morocco is the largest exporter with more than one-fifth share of global exports followed by the US, Russia and China. Together these 4 countries account for around 80% share of the global exports. MAP's increasing use in animal feed and plant fertilizers is the major factor expected to drive the market.



Business Perspective

Plant Level Estimates

300-500 Ktpa
(Ideal Capacity)

200-250 USD Mn
(Investment Estimate)

18-20 Hectares
(Land Requirement)

40-80 USD Mn
(Net GDP Contribution from Operations)

80-100
(Potential Employment Impact)

10%-20%
(IRR)

Direct Investment Model, Joint venture
(Ideal Investment Model)

Scalability & Localization

Few attractive factors for investments in Mono-Ammonium Phosphate in Saudi Arabia are

- Primary Raw Material Availability i.e., Phosphoric acid and Ammonia
- Increasing government focus in Saudi Arabia and Africa on organic farming

Sustainability Implications

Fire Hazard

MAP is not flammable, however wearing full fire-fighting turn-out gear (full Bunker gear) and respiratory protection (SCBA) is advised during firefighting

Monopotassium phosphate (MKP)

Application Perspective

Opportunity Overview

Mono Potassium Phosphate (MKP) also known as Potassium dihydrogen phosphate (KDP), or Monobasic potassium phosphate, is a potassium salt with the formula KH_2PO_4. MKP is formed by reaction of the chloride or carbonate of potassium with phosphoric acid and the phosphate is derived as a crystalline material in a pure form

End-Use Applications

- Traditionally the main commercial applications of MKP were in soft drinks / carbonated drinks and in detergents, but now Ceramicrete has provided a new avenue for its commercial use. It is also finds applications in fertilizer industry.

Feedstock Requirement

- Phosphoric acid
- Potassium hydroxide

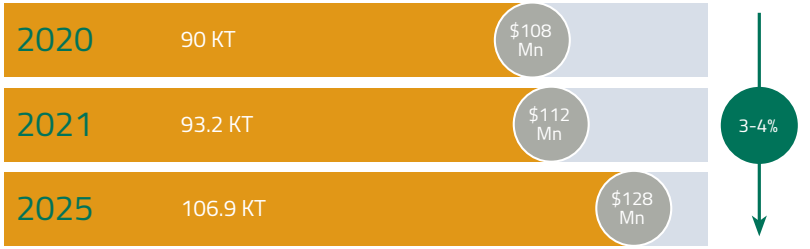
Market Sizing

Global Mono-Potassium Phosphate market is estimated at ~$108 million in 2020 and is expected to reach ~$128 million by 2025, with a CAGR of ~3-4%. In terms of volume, global demand for Mono-Potassium phosphate is estimated at ~90 Kt in 2020 and is expected to reach ~107 Kt by 2025. Increasing demand for feed additives, use of agricultural techniques such as hydroponic which requires a large number of additives per unit yield is projected to fuel the demand for Mono-potassium phosphate.

ME&A Regional Demand —

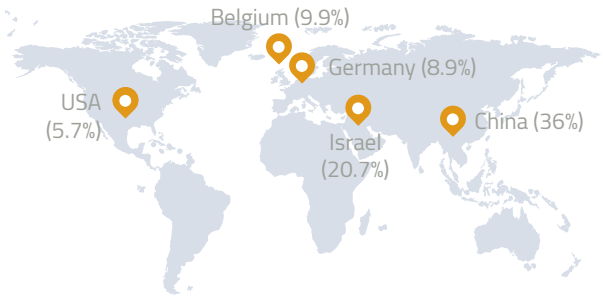
~2,700 tons as of 2020.

Global Monopotassium phosphate (MKP) Demand



Key Countries Supplying

APAC holds the largest share in the global market, owing to growth in pharmaceutical and agricultural industries. China holds more than one-third share of global exports followed by Israel and Belgium. The use of MKP in the Middle east is expected to grow owing to large feed additive demand.



Top Exporters*
% Share of Global Sodium Phosphates Exports

Business Perspective

Plant Level Estimates

500-1,000 tpa
(Ideal Capacity)

1-1.5 USD Mn
(Investment Estimate)

2,000-3,000 Sq. Mts
(Land Requirement)

0.3-0.6 USD Mn
(Net GDP Contribution from Operations)

30-50
(Potential Employment Impact)

10%-20%
(IRR)

Direct Investment Model, Joint venture
(Ideal Investment Model)

Scalability & Localization

Few attractive factors for investments in Mono-Potassium Phosphate in Saudi Arabia are

- Primary Raw Material Availability i.e., Phosphoric acid
- Potential demand from ME on the back of growth in fertilizers and animal feed production

Sustainability Implications

Physical Hazard

Workers should wear protective equipment to prevent skin and eye contact during emergency procedures

Sodium Fluorosilicate

Application Perspective

Opportunity Overview

Sodium Silicofluoride, also known as Sodium Fluorosilicate is a dry, white, free-flowing, crystalline chemical. It is made by neutralizing fluorosilicic acid with sodium chloride or sodium sulfate.

End-Use Applications

Sodium Fluorosilicate is commonly used as an opacifier for use in vitreous enamels and opalescent glass, as a coagulating agent for Latex, in tanning pre-treatments, in zirconium pigments, in the manufacture of frits, enamels and ceramic colors, etc.

Feedstock Requirement

- Fluorosilicic acid
- Sodium chloride/sodium sulfate

Market Sizing

Global Sodium Fluorosilicate market is estimated at ~$30 million in 2020 and is expected to reach ~$40 million by 2025, with a CAGR of ~6%. In terms of volume, global demand for Sodium Fluorosilicate is estimated at ~50 Kt in 2020 and is expected to reach ~67 Kt by 2025. Increase in the production of cement, glass, refractory material, and fertilizers are the major factors driving the growth of the market.

ME&A Regional Demand —

~4,000 tons as of 2020.

Global Sodium Fluorosilicate Demand

Key Countries Supplying

Asia-pacific constitutes a major share of the global market, owing to increase in demand of cement, glass within the construction industry. China to hold the prominent share of market due to increase in the large number of cement companies. Middle East & Africa is anticipated to be the rapidly growing regions due to increasing demand from construction industry.

Business Perspective

Plant Level Estimates

2-4 ktpa
(Ideal Capacity)

2-3 USD Mn
(Investment Estimate)

4,000-6,000 Sq. Mts
(Land Requirement)

1.2-2.4 USD Mn
(Net GDP Contribution from Operations)

20-25
(Potential Employment Impact)

15%-25%
(IRR)

Direct Investment Model, Joint venture
(Ideal Investment Model)

Scalability & Localization

Few attractive factors for investments in Sodium Fluorosilicate in Saudi Arabia are

- Primary Raw Material Availability i.e., Fluorosilicic acid
- Increasing demand from construction industry

Sustainability Implications

Handling and Storage

Sodium Fluorosilicate is not compatible with strong acids (like Hydrochloric acid, sulfuric and nitric acid) and Oxidizing agents (like Peroxides, Chlorates, Nitrates, Chlorine). Thus, it should be stored in tightly closed containers in a cool, well-ventilated area

Low-carbon Cement Clinker

Application Perspective

Opportunity Overview

Clinker is a nodular material produced in the kilning stage during the production of cement and is used as the binder in many cement products. It is essentially a mix of limestone and minerals that have been heated in a kiln and is the backbone of cement production. It is finely ground and mixed with gypsum and often with alternative raw materials to make cement.

End-Use Applications

Cement clinker, combined with additives and ground into a fine powder, is used as a binder in cement products.

Feedstock Requirement

- Limestone
- Clay

Market Sizing

Global Low-carbon Cement Clinker market is estimated at ~$15 billion in 2020 and is expected to reach ~$17 billion by 2025, with a CAGR of ~2%. In terms of volume, global demand for Low-carbon Cement Clinker is estimated at ~500 MMt in 2020 and is expected to reach ~550 MMt by 2025.

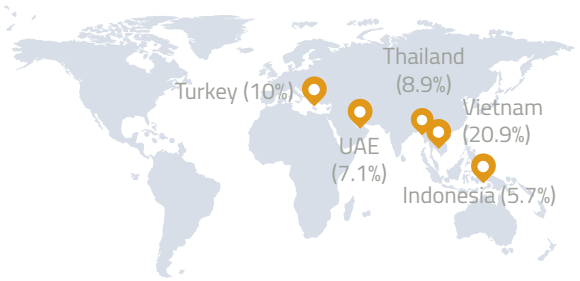
ME&A Regional Demand —

~55 Million tons as of 2020.

Global Low-carbon Cement Clinker Demand

Key Countries Supplying

Vietnam is the largest exporter with more than one-fifth share in the global exports followed by Turkey and Thailand. Construction of infrastructure and booming property industry contributed to increasing domestic consumption of cement in Vietnam in recent years. Urbanization rate of Vietnam is very low, so the consumption of cement is not currently at the peak. China is the biggest importer of Cement Clinker from Vietnam.



Business Perspective

Plant Level Estimates

1.5-2.0 Million Tons
(Ideal Capacity)

60-80 USD Mn
(Investment Estimate)

15-20 Acres
(Land Requirement)

10-20 USD Mn
(Net GDP Contribution from Operations)

70-80
(Potential Employment Impact)

25%-30%
(IRR)

Direct Investment Model, Joint venture
(Ideal Investment Model)

Scalability & Localization

Few attractive factors for investments in Low Carbon Cement in Saudi Arabia are

- Primary Raw Material Availability i.e., Limestone
- Increasing KSA's potential growth in building and construction industry.

Sustainability Implications

Physical Hazard

Cement powder is a respiratory irritant. The dust produced while cutting, drilling, dried concrete and mortar can cause more serious lung disease

Monosodium phosphate (MSP)

Application Perspective

Opportunity Overview

Monosodium phosphate which is also known as anhydrous monobasic sodium phosphate and sodium di-hydrogen phosphate, is a compound of di-hydrogen phosphate and sodium. One among plenty of sodium phosphates used very commonly as an industrial chemical. It exists as an anhydrous salt, as well as mono- and dehydrates.

End-Use Applications

Monosodium Phosphate (MSP) is widely used in the F&B industry in production of baking powders. It is also used in boiling water treatment and as a PH buffer along with other Sodium Phosphates.

Feedstock Requirement

- Phosphoric acid
- Sodium hydroxide

Market Sizing

Global Mono-Sodium Phosphate market is estimated at ~$480 million in 2020 and is expected to reach ~$530 million by 2025, with a CAGR of ~2-3%. In terms of volume, global demand for Mono-Sodium phosphate is estimated at ~480 Kt in 2020 and is expected to reach ~530 Kt by 2025. Increase in the demand from Food & Beverage segment followed by water treatment and feed applications are the major factors driving the market for Mono-Sodium Phosphate.

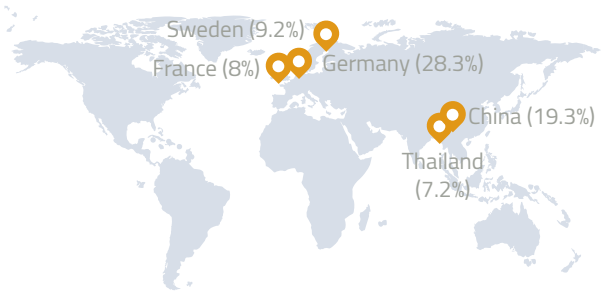
Middle East Regional Demand —

~9,600 tons as of 2020.

Global Monosodium phosphate (MSP) Demand

Key Countries Supplying

Germany is the largest exporter followed by China. Together both the countries account for around half of the global demand. Rise in demand from F&B sector, led by increasing population is the major factor expected to drive the MSP market.



Business Perspective

Plant Level Estimates

500-1,500 tpa
(Ideal Capacity)

1-2 USD Mn
(Investment Estimate)

2,500-3,500 Sq. Mts
(Land Requirement)

0.4-0.8 USD Mn
(Net GDP Contribution from Operations)

40-60
(Potential Employment Impact)

15%-20%
(IRR)

Direct Investment Model, Joint venture
(Ideal Investment Model)

Scalability & Localization

Few attractive factors for investments in Monosodium Phosphate in Saudi Arabia are

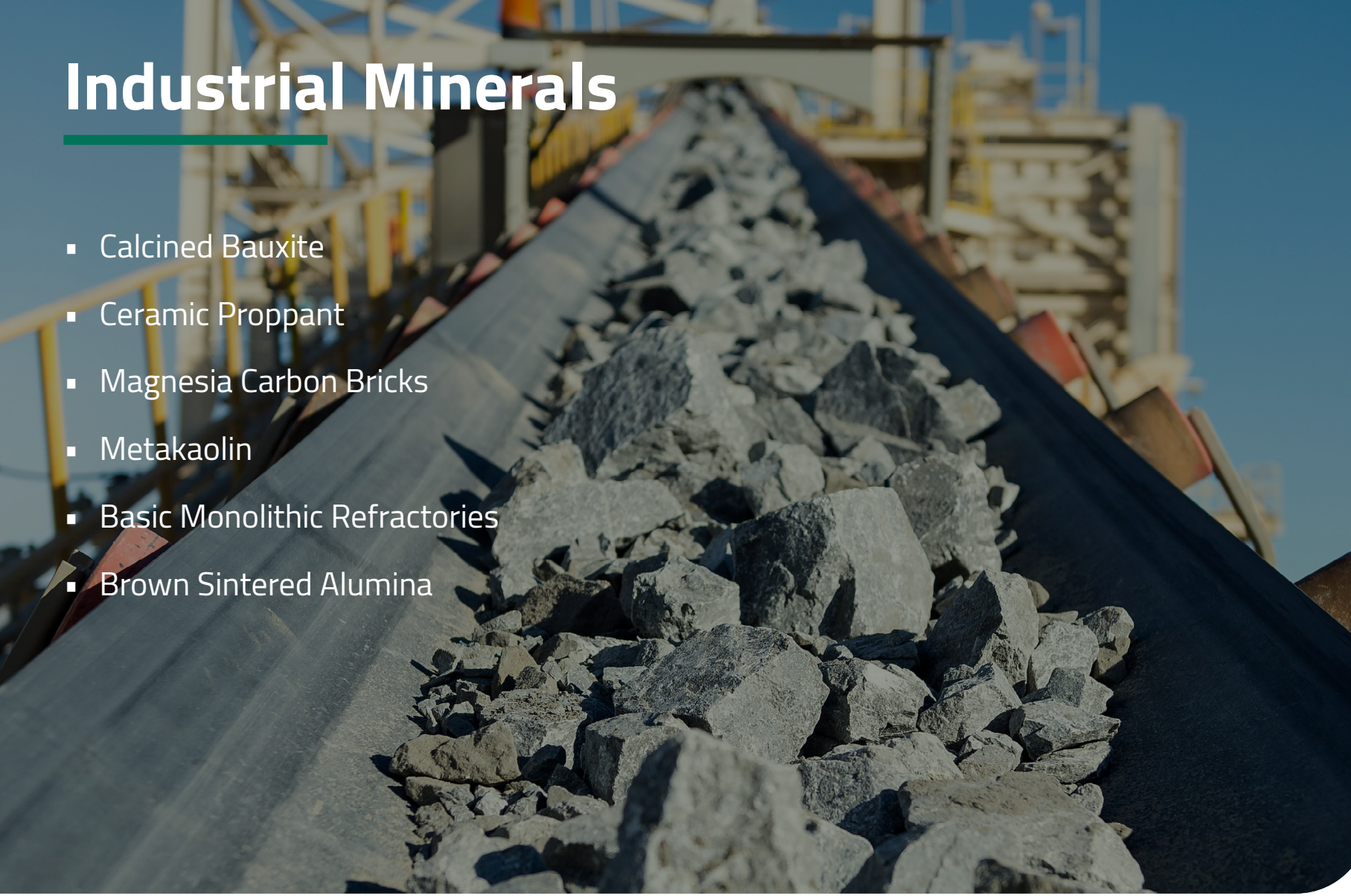
- Primary Raw Material Availability i.e., Phosphoric acid
- Potential demand from ME in Food & Beverage segment

Sustainability Implications

Storage

Monobasic sodium phosphate is chemically stable, although it is slightly deliquescent. Monobasic sodium phosphate should be stored in an airtight container in a cool, dry place.

Industrial Minerals



- Calcined Bauxite
- Ceramic Proppant
- Magnesia Carbon Bricks
- Metakaolin
- Basic Monolithic Refractories
- Brown Sintered Alumina

Calcined Bauxite

Application Perspective

Opportunity Overview

Calcined bauxite, also known as Refractory bauxite, is produced by sintering raw bauxite at higher temperatures (more than 1500 °C). This results in a product with high aluminium content, low degree of impurity and heat resistant. Due to this, Calcined bauxite is often used as one of the most important raw materials for the manufacture of shaped and unshaped refractory products.

End-Use Applications

Calcined bauxite is primarily used in refractory and abrasive applications. Smaller volumes of calcined bauxite are also consumed in other applications such as proppant, welding fluxes and antiskid surfaces.

Feedstock Requirement

- Raw Bauxite

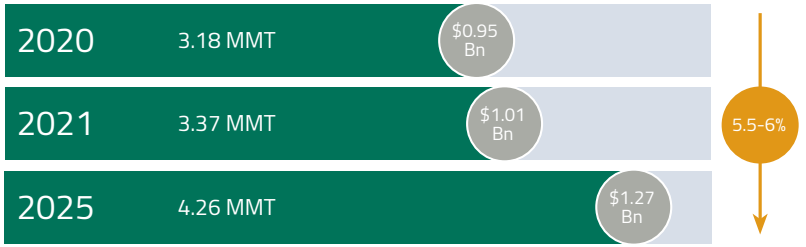
Market Sizing

Global Calcined bauxite market is estimated at ~$0.95 billion in 2020 and is expected to reach ~$1.27 billion by 2025, with a CAGR of ~5.5-6%. In terms of volume, global demand for Calcined Bauxite is estimated at ~3.2 Mt in 2020 and is expected to reach ~4.3 Mt by 2025. Increased demand for from construction (for steel making), cement and chemicals sectors is the major growth driver for calcined bauxite market.

ME Regional Demand —

~32,000 tons as of 2020.

Global Calcined Bauxite Demand



Key Countries Supplying

Calcined bauxite or refractory bauxite is majorly supplied by countries such as China, Russia, India and Guyana. Other smaller producers such as Brazil, Greece, Malaysia, and Australia supply smaller amounts of refractory grade bauxite, which is majorly consumed in the domestic market and also for proppant production.

Business Perspective

Plant Level Estimates

50-75 Ktpa
(Ideal Capacity)

5-8 USD Mn
(Investment Estimate)

1,500-2,000 Sq. Mts
(Land Requirement)

6-10 USD Mn
(Net GDP Contribution from Operations)

20-30
(Potential Employment Impact)

20%-25%
(IRR)

Direct Investment Model, Joint venture
(Ideal Investment Model)

Scalability & Localization

Few attractive factors for investments in Calcined Bauxite in Saudi Arabia are

- Primary Raw Material Availability – Bauxite
- KSA's plans to increase Industrial minerals activity and related downstream applications

HSE Implications

Hazardous Emissions

Calcination process could result in emissions of hazardous elements such as NOx, CO, dust and SO2

Ceramic Proppant

Application Perspective

Opportunity Overview

Ceramic proppants are manufactured from sintered bauxite, kaolin, or blends of bauxite and kaolin. It is uniform in size and share, has higher strength and is crush resistant. Ceramic proppants have highest chemical and thermal stability. All of these properties in turn makes it highly conductive both in short and long term inside a fracture. Based on the density, they can be divided into 3 groups - lightweight ceramics , inter-mediate density ceramics (IDC) and high-density ceramics (HDC).

End-Use Applications

Ceramic proppants are widely used in hydraulic fracturing of oil and gas formations

Feedstock Requirement

Ceramic proppant can be produced from various raw materials. Primary raw materials which can be used as feedstock are

- Bauxite, Kaolin, Bauxitic Kaolin, Bauxite/Kaolin Blends

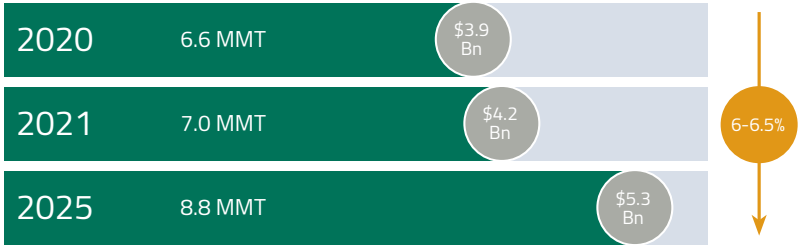
Market Sizing

Global Ceramic Proppant market is estimated at ~$3.9 billion in 2020 and is expected to reach ~$5.3 billion by 2025, with a CAGR of ~6%. In terms of volume, global demand for Ceramic Proppant is estimated at ~6.6 MMt in 2020 and is expected to reach ~8.8 MMt by 2025. Increasing demand from hydraulic fracturing applications from oil & gas industry is the major reason driving the demand for ceramic proppant.

ME&A Regional Demand —

~100,000 tons as of 2020.

Global Ceramic Proppant Demand



Key Countries Supplying

North America is a leading region for the global ceramic proppant market. Increasing demand for proppant materials from oil & gas companies is the major factor driving the growth of the market in North America.

Business Perspective

Plant Level Estimates

40-60 Ktpa
(Ideal Capacity)

20-40 USD Mn
(Investment Estimate)

15,000-20,000 Sq. Mts
(Land Requirement)

9-14 USD Mn
(Net GDP Contribution from Operations)

80-100
(Potential Employment Impact)

15%-20%
(IRR)

Direct Investment Model, Joint venture
(Ideal Investment Model)

Scalability & Localization

Few attractive factors for investments in Ceramic proppants in Saudi Arabia are

- Primary Raw Material Availability i.e., Bauxite
- Potential demand from fracturing applications across the Middle East

Sustainability Implications

Less Negative Impact on Environment

From HSE perspective, ceramic proppant has less negative impact on environment compared to other proppant technologies

Magnesia Carbon Bricks

Application Perspective

Opportunity Overview

MGO-C brick is a composite material based on MGO and C, bonded with high carbon containing pitch and resin. It has contained metallic powder as antioxidants to protect the carbon. They are made by high pressure and show high resistance to thermal shock and slag corrosion at elevated temperatures.

End-Use Applications

MGO-C bricks are generally used in steel making processes - Converters, AC Electric Arc Furnace, DC Arc Furnace etc.

Feedstock Requirement

- Magnesium Oxide
- Flake graphite
- Antioxidants
- Resin components

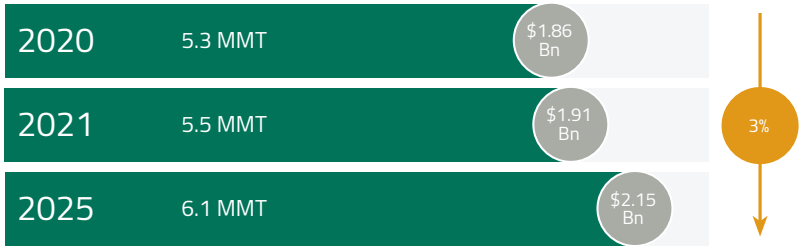
Market Sizing

Global MGO-C brick market is estimated at ~$1.9 billion in 2020 and is expected to reach ~$2.2 billion by 2025, with a CAGR of ~3%. In terms of volume, global demand for MGO-C brick is estimated at ~5.3 MMt in 2020 and is expected to reach ~6.1 MMt by 2025. Increasing demand from steel processing applications is again contributing to the market growth

ME Regional Demand —

~159,000 tons as of 2020.

Global Magnesia Carbon Bricks (MGO-C brick) Demand



Key Countries Supplying

Asia-Pacific dominates the MGO-C bricks supply. The region has plenty of magnesite deposits, from which MGO-C bricks are made. Also, the region is the highest steel producer, there by necessitating the need for MGO-C supply within region. China is the major country leading the supply and demand.

Business Perspective

Plant Level Estimates

20-30 Ktpa
(Ideal Capacity)

10-15 USD Mn
(Investment Estimate)

8-10 Acres
(Land Requirement)

3-5 USD Mn
(Net GDP Contribution from Operations)

50-80
(Potential Employment Impact)

20%-25%
(IRR)

Direct Investment Model, Joint venture
(Ideal Investment Model)

Scalability & Localization

Few attractive factors for investments in MGO-C Bricks in Saudi Arabia are

- Potential demand for refractory materials across the Middle East
- Strategic importance of MGO-C bricks for steel industry continuity

Environmental Impact

MGO-C brick product systems are prone to more environmental impact than carbonless bricks. In terms of major impact categories such as water depletion and particulate matter formation, carbonless bricks achieves ~70% relative reductions in each category

Metakaolin

Application Perspective

Opportunity Overview

Metakaolin (MK) is a type of clay which comes from calcination of kaolin clay. It is the anhydrous calcined form of the clay mineral kaolinite. Metakaolin is produced by controlled thermal treatment of kaolin, where it is heated to temperatures between 600 and 850°C.

End-Use Applications

The principal applications for metakaolin are ceramics, refractories, mortars, geopolymers and concrete admixtures which encompasses applications including infrastructure works, commercial, industrial and residential buildings, artefacts and other.

Feedstock Requirement

- Kaolin clay

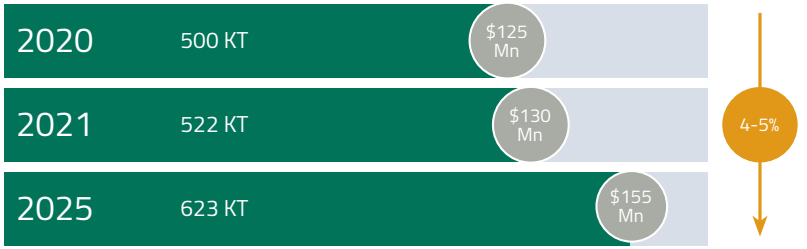
Market Sizing

Global Metakaolin market is estimated at ~$125 million in 2020 and is expected to reach ~$155 million by 2025, with a CAGR of ~4-5%. In terms of volume, global supply of metakaolin is estimated at ~500 Kt in 2020 and is expected to reach ~620 Kt by 2025. The primary factor driving the metakaolin market is growth of the construction industry. Also, Metakaolin use in offshore construction, water retaining structures, mass concreting and nuclear power stations has increased in recent years, increasing the demand.

ME Regional Demand —

~17,500 tons as of 2020.

Global Metakaolin Demand



Key Countries Supplying

Most of the Metakaolin plants are in the US, India and Europe. This can be attributed to raw material availability, Kaolin clay. Kaolin mines can be majorly found in countries such as China, India, South East-Asia, US, Australia and many European countries. Among these, Chinese clay is generally considered to be very pure.

Business Perspective

Plant Level Estimates

20-30 Ktpa
(Ideal Capacity)

4-6 USD Mn
(Investment Estimate)

6,000-7,000 Sq. Mts
(Land Requirement)

2-4 USD Mn
(Net GDP Contribution from Operations)

20-30
(Potential Employment Impact)

15%-20%
(IRR)

Direct Investment Model, Joint venture
(Ideal Investment Model)

Scalability & Localization

Few attractive factors for investments in Metakaolin in Saudi Arabia are

- Better permeability barrier, better compressive and flexural strength than normal construction materials make it better choice for special construction and oilfield applications.
- Lower CO_2 emissions compared to other construction materials.

HSE Implications

Employee Safety against inhalation

Kaolin clay may contain up to 2% quartz. Quartz is classified as carcinogenic to humans by inhalation and prolonged exposure is a potential health hazard

Basic Monolithic Refractories

Application Perspective

Opportunity Overview

Refractories are ceramic materials designed to withstand very high temperatures. Monolithic refractories refer to all unshaped refractory products. They are a group of products which with the addition of water, are cast into place. Castables are supplied dry, mixed onsite and installed behind shuttering or cast in a mould to form the required shape. Monolithic materials include plastic mixes, castables, ramming materials, dry vibratables, gunning materials, fettling materials, coatings and mortars

End-Use Applications

Monolithic refractories are mainly used in non-ferrous industrial applications such as metallurgical, steel, cement, petrochemical, and waste disposal industries.

Feedstock Requirement

Refractories are produced from natural and synthetic materials, usually nonmetallic, or combinations of compounds and minerals such as alumina, fireclays, bauxite, chromite, dolomite, magnesite, silicon carbide, and zirconia.

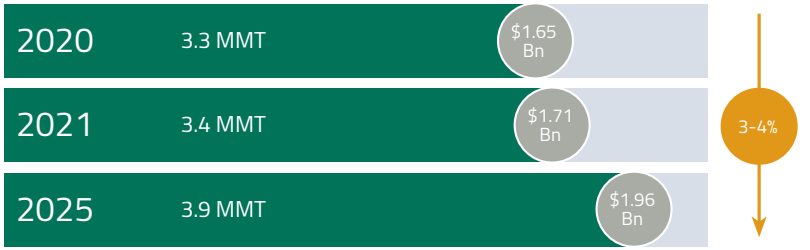
Market Sizing

Global Basic Monolithic Refractories market is estimated at ~$1.65 billion in 2020 and is expected to reach ~$1.96 billion by 2025, with a CAGR of ~3-4%. In terms of volume, global supply of Basic Monolithic Refractories is estimated at ~3.3 MMt in 2020 and is expected to reach ~3.9 MMt by 2025. The primary factor driving the Basic Monolithic Refractories market is the technological changes and increasing demands for greater furnace output have made it imperative to turn to newer refractories and refractory installation techniques.

ME Regional Demand —

~66,000 tons as of 2020.

Global Basic Monolithic Refractories Demand



Key Countries Supplying

China is the major supplier and consumer of refractory materials and is expected to drive market growth in the short term. Increasing population, which in turn is creating vast usage of refractory materials in steel and automotive industry is the major factor expected to drive the country's market growth. Apart from China, Germany and the US is dominating the markets in the Europe and in North America respectively on the back of growing automotive industry.

Business Perspective

Plant Level Estimates

30-40 Ktpa
(Ideal Capacity)

10-15 USD Mn
(Investment Estimate)

6,000-8,000 Sq. Mts
(Land Requirement)

5-7 USD Mn
(Net GDP Contribution from Operations)

40-50
(Potential Employment Impact)

15%-20%
(IRR)

Direct Investment Model, Joint venture
(Ideal Investment Model)

Scalability & Localization

Few attractive factors for investments in Basic Monolithic Refractories in Saudi Arabia are

- Primary Raw Material Availability
- Upcoming potential demand from industrial sector

Sustainability Implications

Hazardous Air Pollutant Emissions

Refractory manufacturing units are sources of several HAPs. Resin-bonded refractory curing ovens and kilns can emit phenol, formaldehyde, methanol, and ethylene glycol, depending on the type of resin used.

Brown Sintered Alumina

Application Perspective

Opportunity Overview

Introduced to the global market in 2010, Brown Sintered Alumina is a type of sintered alumina aggregate and is often referred to as BSA 96. Sintered aggregates are more reactive than fused aggregates of similar chemistry. BSA 96 is generally available in sizes from 0.06 mm to 15 mm. Tabular alumina and BSA 96 show a clear advantage over fused materials with regards to corrosion because of their closed porosity and the very fine pore structure of the open pores.

End-Use Applications

Approximately 2/3rds of the BSA is used in castables and other monolithic mixes as a replacement for brown fused alumina or as an up-grade for bauxite-based materials

Feedstock Requirement

Raw Bauxite

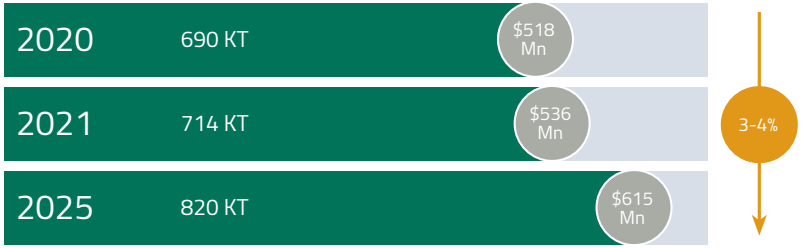
Market Sizing

Global Brown Sintered Alumina market is estimated at ~$228 million in 2020 and is expected to reach ~$270 million by 2025, with a CAGR of ~3.5%. In terms of volume, global supply of Brown Sintered Alumina is estimated at ~300 Kt in 2020 and is expected to reach ~360 Kt by 2025. Increasing demand for metal abrasives, coated abrasives, resin-bonded abrasive products for industrial, metallurgical and automotive sector is likely to drive the market demand.

ME Regional Demand —

~82,800 tons as of 2020.

Global Brown Sintered Alumina Demand



Key Countries Supplying

APAC holds the largest share of the global supply of brown sintered alumina. The region's vast bauxite resources and alumina and other product manufacturing facilities are the major reason behind the region's strong foothold in global supply. Apart from APAC, is one of the major supplier as demand for metal abrasives and alumina products is high in the region.

Business Perspective

Plant Level Estimates

25-35 Ktpa
(Ideal Capacity)

8-10 USD Mn
(Investment Estimate)

3,000-4,000 Sq. Mts
(Land Requirement)

12-18 USD Mn
(Net GDP Contribution from Operations)

40-50
(Potential Employment Impact)

10%-15%
(IRR)

Direct Investment Model, Joint venture
(Ideal Investment Model)

Scalability & Localization

Few attractive factors for investments in Brown Sintered Alumina in Saudi Arabia are

- Primary Raw Material Availability
- KSA's potential growth in building and construction industry.

Sustainability Implications

NaCl Presence

Presence of NaCl particles during sintering process could stimulate corrosion

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