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**GLOBAL VINYL ESTER**

**RESIN MARKET**

**FORECAST & OPPORTUNITIES,2015-2030**

**PUBLISHED: September 2021**

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**MARKET INTELLIGENCE. CONSULTING**

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| --- | --- | --- | --- | --- | --- |
| **S. No.** | **Contents** | | | | **Page No.** |
| **1.** | **Executive Summary** | | | | **5** |
|  | 1.1 | Overview of the Company | | |  |
|  | 1.2 | Brief Profile of Board of Directors | | |  |
|  | 1.3 | Brief Project summary | | |  |
|  | 1.4. | Key Highlights of The Project | | |  |
| **2.** | **Product Profile** | | | | **9** |
| **3.** | **Market Outlook and Relevance of the Project** | | | |  |
|  | **3.1** | **Demand Supply Outlook – Global Vinyl Ester Resin Market** | | | **14** |
|  |  | 3.1.1. | Capacity By Company & Location | |  |
|  |  | 3.1.2. | Production By Company | |  |
|  |  | 3.1.3. | Operating Efficiency | |  |
|  |  | 3.1.4. | Demand By Type | |  |
|  |  | 3.1.5. | Demand Supply Gap | |  |
|  |  | 3.1.6. | Demand By Sales Channel | |  |
|  |  | 3.1.7. | Demand By Application | |  |
|  |  | 3.1.8. | Sales By Company | |  |
|  |  | 3.1.9. | Demand By Region- Global | |  |
|  | **3.2** | **APAC Demand Supply Outlook** | | | **27** |
|  |  | 3.2.1. | APAC Capacity & Production | |  |
|  |  | 3.2.2. | Capacity By Location | |  |
|  |  | 3.2.3. | APAC Vinyl Ester Resin Demand | |  |
|  |  | 3.2.4. | Operating Efficiency | |  |
|  |  | 3.2.5. | Demand By Application | |  |
|  |  | 3.2.6. | Demand By Type | |  |
|  |  | 3.2.7. | APAC Demand Supply Gap | |  |
|  |  | 3.2.8. | Demand By Sales Channel | |  |
|  |  | 3.2.9. | Sales By Company | |  |
|  | **3.3.** | **Europe Demand Supply Outlook** | | | **37** |
|  |  | 3.3.1. | Europe Capacity & Production | |  |
|  |  | 3.3.2. | Capacity By Location | |  |
|  |  | 3.3.3. | Vinyl Ester Resin Demand | |  |
|  |  | 3.3.4. | Operating Efficiency | |  |
|  |  | 3.3.5. | Demand By Application | |  |
|  |  | 3.3.6. | Demand By Type | |  |
|  |  | 3.3.7. | Europe Demand Supply Gap | |  |
|  |  | 3.3.8. | Demand By Sales Channel | |  |
|  |  | 3.3.9. | Sales By Company | |  |
|  | **3.4.** | **North America Demand Supply Outlook** | | | **44** |
|  |  | 3.4.1. | North America Capacity & Production | |  |
|  |  | 3.4.2. | North America Vinyl Ester Resin Demand | |  |
|  |  | 3.4.3. | Operating Efficiency | |  |
|  |  | 3.4.4. | Demand By Application | |  |
|  |  | 3.4.5. | Demand By Type | |  |
|  |  | 3.4.6. | Demand By Sales Channel | |  |
|  |  | 3.4.7. | North America Demand Supply Gap | |  |
|  |  | 3.4.8. | Sales By Company | |  |
|  | **3.5.** | **South America Demand Supply Outlook** | | | **52** |
|  |  | 3.5.1. | North America Capacity & Production | |  |
|  |  | 3.5.2. | North America Vinyl Ester Resin Demand | |  |
|  |  | 3.5.3. | Operating Efficiency | |  |
|  |  | 3.5.4. | Demand By Application | |  |
|  |  | 3.5.5. | Demand By Type | |  |
|  |  | 3.5.6. | Demand By Sales Channel | |  |
|  |  | 3.5.7. | North America Demand Supply Gap | |  |
|  |  | 3.5.8. | Sales By Company | |  |
|  | **3.6.** | **Middle East & Africa Demand Supply Outlook** | | | **59** |
|  |  | 3.6.1. | Middle East & Africa Capacity & Production | |  |
|  |  | 3.6.2. | Middle East & Africa Vinyl Ester Resin Demand | |  |
|  |  | 3.6.3. | Operating Efficiency | |  |
|  |  | 3.6.4. | Demand By Application | |  |
|  |  | 3.6.5. | Demand By Type | |  |
|  |  | 3.6.6. | Demand By Sales Channel | |  |
|  |  | 3.6.7. | Middle East & Africa Demand Supply Gap | |  |
|  |  | 3.6.8. | Sales By Company | |  |
|  | **3.7.** | **India Demand Supply Outlook** | | | **66** |
|  |  | 3.7.1. | India Capacity & Production | |  |
|  |  | 3.7.2. | Operating Efficiency | |  |
|  |  | 3.7.3. | India Vinyl Ester Resin Demand | |  |
|  |  | 3.7.4. | Demand By Type | |  |
|  |  | 3.7.5. | India Demand Supply Gap | |  |
|  |  | 3.7.6. | Demand By Application | |  |
|  | **3.8.** | **Market Dynamics** | | | **73** |
|  | **3.9.** | **Market Trends and Developments** | | | **76** |
|  | **3.10.** | **Technology Evaluation** | | | **78** |
|  | **3.11.** | **Pricing Analysis** | | | **79** |
|  | **3.12.** | **Value Chain Analysis** | | | **81** |
|  | **3.13.** | **Cost of Production** | | | **83** |
|  | **3.14.** | **Customer Analysis** | | | **84** |
|  | **3.15.** | **Global Foreign Trade Analysis** | | | **86** |
|  | **3.16.** | **Suggested Capacities** | | | **88** |
| **4.** | **Project Description** | | | | **90** |
|  | **4.1.** | Setup related details | | |  |
|  |  | 4.1.1. | | Target End-Use Application |  |
|  |  | 4.1.2. | | Plant Process Description |  |
|  |  | 4.1.3. | | Process Flow Diagram & Technology Licensor |  |
|  |  | 4.1.4. | | Major Equipment List |  |
|  |  | 4.1.5. | | Technology Licensor |  |
|  |  | 4.1.6. | | Utilities Overview |  |
|  |  | 4.1.7. | | Waste generation, management and disposal |  |
|  |  | 4.1.8. | | Raw material required |  |
|  |  | 4.1.9. | | Upcoming Developments in Technology |  |
| **5.** | **Economic Evaluation** | | | | **101** |
| **6.** | **Research Methodology** | | | | **104** |

**Executive Summary**

**Brief insight about the company and project:**

****

**Established - 1973 Turnover (Consolidated) - INR 5,39,238 Crore (FY Year 2020-21)**

* 1. **Overview of the Company:**
* India based Reliance Industries Limited, one of the well-known MNCs which manufacture and sale diverse range of products including polymers, aromatics, elastomers etc. globally.
* The company caters customers and various industries viz., healthcare, automotive, packaging etc across over 70 countries worldwide.
* The company’s total production capacity of PE, PP and PVC is 2.3, 2.9 and 0.7 million MT per annum, respectively as of 2019.
* The company exported 1.1 million MT of polymers globally in 2019.
* The company has 6 state-of-the-art manufacturing facilities to produce polymers.

**1.2 Brief Profile of Board of Directors:**

**Mukesh Ambani:** Mr. Mukesh D. Ambani (DIN 00001695) is a Chemical Engineer from the Institute of Chemical Technology, Mumbai (erstwhile the University Department of Chemical Technology, University of Mumbai). He pursued an MBA from Stanford University in the US. He has been on the Board of Reliance since 1977.

**Nita M. Ambani:** Mrs. Nita M. Ambani (DIN 03115198) is a Commerce Graduate from Mumbai University and a diploma holder in Early Childhood Education.

**Hital R. Meswani:** Mr. Hital R. Meswani (DIN 00001623) is a Management & Technology graduate from the University of Pennsylvania (UPenn) in the USA.

**Nikhil R. Meswani:** Nikhil Meswani is an Executive Director on the Board of Reliance. A chemical engineer from the University Institute of Chemical Technology (UICT) Mumbai, he joined Reliance in 1986.

**P.M.S. Prasad:** PMS Prasad is an Executive Director at Reliance and one of the longest serving members on the Board and the company.

**P.K. Kapil:** PK Kapil is an Executive Director on the Board of Reliance. With experience spanning four decades, he is a driving force in the HSE, Technology, Reliability and Operations of all manufacturing sites.

**R.A. Mashelkar:** R.A. Mashelkar is an independent Director on the Board of Reliance. An eminent scientist and champion of the Innovation Movement in India, he is the Chairman of Reliance Innovation Council.

**Adil Zainulbhai:** Adil Zainulbhai is an independent Director on the Board of Reliance. One of the world’s foremost consultants, he is a mechanical engineering graduate from IIT and holds an MBA from Harvard.

**Mansingh L. Bhakta:** Mansingh Bhakta is an independent Director on the Board of Reliance. An advocate par excellence, he has almost six decades of experience.

**Dipak C. Jain:** Dipak Jain is an independent Director on the Board of Reliance. One of the world’s top educationalists, he is a former Dean of Kellogg School of Management and INSEAD.

**Dharam Vir Kapur:** Dharam Vir Kapur is an independent Director on the Board of Reliance. A technology, industrial development, and project implementation expert, he has a long and illustrious career in the Indian government.

**Mahesh P. Modi:** Mahesh Modi is an independent Director on the Board of Reliance. He has in-depth management experience in the petrochemical, telecommunications, energy, and insurance industries.

**Yogendra P. Trivedi:** Yogendra Trivedi is an independent Director on the Board of Reliance. He is an expert in the fields of economics, politics, education, sports, and social and professional services.

**Ashok Misra:** Ashok Misra is an independent Director on the Board of Reliance. An IIT Director from 2000-2008, Misra was the driving force behind its transformation into a leading research and development institute.

**1.3 Brief Project Summary:**

The client intends to establish a manufacturing facility or the production of vinyl ester resin to cater the potential demand in domestic market as well as export sales in neighbouring regions. To assess this opportunity the client has thus requested TechSci Research for undertaking feasibility study covering the following datapoints:

* Market Analysis and Forecast 2015 – 2030F (By Application, By Type, By Sales Channel)
* Regions – Asia Pacific, Europe, North America, South America, Middle East & Africa.
* Customer Analysis
* Production Process Overview, Technology Evaluation and Cost Tear Analysis by Component.
* Project Economic Evaluation
* Strategic Recommendations
* Other Value-Added Data such as carbon footprint overview, Pricing Analysis, Market Trends and Development.

Vinyl ester resins (VERs) are high-performance unsaturated resins derived by the addition reaction of various epoxide resins with unsaturated carboxylic acids. These resins have been classified under unsaturated polyester resins & comes with different grades such as Bisphenol-A Epoxy Resin, Low styrene Monomer Bisphenol-A Resin, Novolac Based Epoxy Resin, Brominated Epoxy Resin, and multifunctional epoxy resins.

Vinyl ester resin are easy to manufacture as process is simple and all raw materials are available. Backward integration into raw materials such as Epoxy Resin, Styrene and Methacrylic Acid will allow consistent supply and competitive pricing of vinyl ester resin.

**1.4 Key Highlights of the projects**

Reliance Industries Limited (RIL) proposes to enter Vinyl Ester Resin business. With the increasing demand within India and across the globe, there is a great opportunity to enter in this manufacturing business. The company’s total production capacity of PE, PP and PVC is 2.3, 2.9 and 0.7 million MT per annum, respectively as of 2019.Success for the greenfield project is mainly due to:

* Cost Competitiveness against all major companies operating in the market
* Early Adaptation of 5G Technology by telecom sector
* India being the Top 10 preference for FDI Inflows in the country.
* India being the 4th largest producer of Chemicals in Asia Pacific region.
* “AatmaNirbhar Bharat” and “Make in India” policies are further incentivizing domestic manufacturer to come up with green field capacity.

Demand for vinyl ester resin has been proposed to have double digit growth in India due to the robust growth in end user industries. India’s Fiberglass Reinforced Plastics (FRP) coating and lining Industry has been witnessing high growth numbers due to increasing inclination towards corrosion resistant products and other technological advancements. Vinyl ester resin is also finding its wide applications majorly in materials for pipe linings, steel and concrete linings, secondary containment, and to fabricate FRP (Fiberglass Reinforced Plastics) storage tanks. Vinyl ester resin prevents the hydrolysis induced osmotic blistering by the formation of skin between the gel coat and the glass/polyester laminate or over the gel coat. It can be used for the entire lamination of boats which provides greater flexibility and toughness than polyester.

**Growth Drivers for India Vinyl Ester Market**

|  |  |  |  |
| --- | --- | --- | --- |
| **Name of the Product** | **Domestic Demand Market** | **Export Potential** | **Import Substitution** |
| FRP (Pipes and Tanks) |  |  |  |
| Electronics and Telecommunication |  |  |  |
| Marine Components |  |  |  |
| Renewable Energy (Wind) |  |  |  |
| Aerospace and Defense |  |  |  |
| Chemical Storage |  |  |  |

**Product Profile**

**2.1. Product Overview (Introduction and Characteristics):**

Vinyl Ester Resins are intermediate between polyester and epoxy resin specifically designed for greater resistance to vibrational loads. They are thermosetting group of resins derived from the reaction of epoxy resin and unsaturated carboxylic acid group such as methacrylic or acrylic acid.

Vinyl Ester Resin forms cross linking between epoxy backbone and functional side groups leaving fewer area to attach water molecule which means these resins are very resistant to water and other chemicals. As they are less susceptible to damage by hydrolysis, therefore find applications in pipes and chemical storage tanks, marine, recreation industries etc. This type of side group cross linking also provides vinyl ester resin with excellent thermal stability and are frequently found in applications such as semiconductor encapsulation, electronics, and communication, construction, and automobile industries.

Few globally used grades of vinyl ester resin are described below

|  |  |  |
| --- | --- | --- |
| **S. No** | **Grade** | **Application** |
| **1** | **Bisphenol-A Epoxy Based Vinyl Ester Resin** | **Provide Resistance to acid, alkalis, solvents, excellent toughness, and fatigue resistance** |
| **2** | **Low styrene Monomer Bisphenol-A Vinyl Ester Resin** | **Chemical reaction vessels** |
| **3** | **Novolac Based Epoxy Vinyl Ester Resin** | **Excellent, thermal, and chemical resistance, resistance to solvents, acids** |
| **4** | **Brominated Epoxy Based Vinyl Ester Resin** | **High degree of fire retardance, resistance to chemical, tougher and fatigue resistant** |
| **5** | **Brominated Novolac Epoxy Based Vinyl Ester Resin** | **Moderate degree of retardance, application in hot, wet flue gas environment** |
| **6** | **Elastomer-modified Bisphenol-A Epoxy Based Vinyl Ester Resin** | **High impact and fatigue resistance, chemically resistant FRP linings** |
| **7** | **Urethane Modified Vinyl Ester Resin** | **Heat, Corrosion and Chemical resistant, application in marine, pultrusion, carbon fibre** |

With the growing fibre reinforced composites market in the Asia Pacific, the demand is high for predictable and cohesive vinyl ester resin and polyester resin systems. The experience of composites in quality infrastructure over the last 30 years has provided the boulders for new corrosion infrastructure applications that shall apply to Asian as well as global markets.

The usage of fiberglass reinforced underground gasoline storage tanks has been successful in the last quarter century. Power station pipes, some as large as 4.9 meters in diameter, have been performing well without any problem. The recently developed composite products include sewer liners, short span bridges for handling pedestrian bridges, regular road traffic, water covers for water treatment plants.

Vinyl ester resin composites have achieved a remarkable degree of commercial acceptance in a variety of applications like infrastructure, chemical and marine industry.

Polyester and Vinyl Ester Resins are among the most used matrix resins to create polymer composites. The formulations of Vinyl ester have been providing increased corrosion resistance and have a broad range of heat distortion, available strength, and shrinkage characteristics. The automotive and transportation industry is expected to drive the demand for composite materials. As the strength-to-weight ratio of most composites is higher than that of steel and aluminium. Vinyl ester resin stands serve as the intermediate chemical of epoxy and polyester in terms of mechanical properties and price.

**2.2 Production routes & related details**

Vinyl ester resin Technology is typically developed in-house with the critical equipment being outsourced. It requires in-house independent R & D, equipped with latest state of art technologies and facilities. Vinyl Ester Resin is mainly of three types, namely Bisphenol A, F, S Vinyl Ester Resin, Novolac Vinyl Ester Resin, and Brominated Vinyl Ester Resin.

Some applications of Novolac vinyl ester resin includes heat shields, resistance coatings, parts for flue gas desulfurization, chimney liners, and other structural composite components where high heat resistance is required. The Brominated vinyl ester resins are flame retardant and provide corrosion resistance from a wide variety of acidic and alkaline environments.

Novolac based vinyl ester resin, despite possessing better properties than Bisphenol A vinyl ester resin, holds less share than Bisphenol A as the technology to manufacture is quite complex, expensive, requires infrastructure, raw materials, & above all expertise. Others include urethane and elastomer modified vinyl ester resins which are modified with many unique features, providing exceptional characteristics. The elastomer modified may also be used as a primer on carbon steel, high density PVC foam and other dissimilar substrates.

**Production Route for producing Bisphenol A Based Vinyl Ester Resin:**

Firstly, Epoxy resin and Bisphenol A are added to the reactor and heated to the temperature of 170°C and that temperature should be maintained for a period of 2-4 hours. Secondly, Epoxy equivalent weight is measured and after an optimum value has been achieved then it is allowed to cool down to 100°C and then finally to 80°C. Solid resins from the reactor is then discharged into blender containing blender and the temperature of the discharge resin should not rise above 70°C. To limit the temperature to the required limit water needs to be circulated around the blender. Finally, viscosity, gel time etc testing are to be done and should be adjusted accordingly.

|  |  |  |  |
| --- | --- | --- | --- |
| **INPUT** | **‘QUANTITY (MT/MT)** | **OUTPUT** | **QUANTITY (MT/MT)** |
| Epoxy Resin | 0.30 | Vinyl Ester Resin | 1.0 |
| Bisphenol-A | 0.14 | By Product | Nil |
| Methacrylic Acid | 0.11 | Yield Loss | 0.00 |
| Styrene Monomer | 0.44 | Gaseous | - |
| **Total** | **1.00** | **Total** | **1.00** |

**Mass Balance:**

**Production Route for Novolac Based Vinyl Ester Resin:** Epoxidized novolac vinyl ester resin is synthesized by reacting epoxidized novolac resin and methacrylic acid (MA) in molar ratio 1:0.9 and in presence of triphenylphosphine as catalyst at 85-90°C. The epoxidized novolac resin was prepared by the reaction of novolac-type phenolic resin and epichlorohydrin, in basic medium, at 120°C.The Epoxidized novolac vinyl ester resin is cured by using the mixture of resin, benzoyl peroxide, and styrene at 120°C. The resin was found to be cured in 60min at 120°C.

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**Mass Balance:**

|  |  |  |  |
| --- | --- | --- | --- |
| **INPUT** | **QUANTITY (MT/MT)** | **OUTPUT** | **QUANTITY (MT/MT)** |
| Epoxy Resin (Novalac Based) | 0.4 | Vinyl Ester Resin | 1 |
| Methacrylic Acid | 0.12 | By Product | Nil |
| Triphenylphosphine/ Triethyl amine | 0.01 | Yield Loss | - |
| Maleic Anhydride (as Stabalizer) | 0.03 | Gaseous | - |
| Styrene Monomer | 0.44 | Solid waste | - |
| **Total** | **1** | **Total** | **1** |

**Production Route for Brominated Epoxy Vinyl Ester Resin:** The epoxy resin and methyl acrylate/ethyl acrylate were charged in Reactor Vessel. The mixture was heated at 90°C -100°C in presence of triethylamine used as a base catalyst and hydroquinone as an inhibitor. The esterification reaction was done for 6 hours. The synthesized resin was dissolved in toluene and filtered to remove salt. Toluene was distilled off under reduce pressure and the product was dried in the oven at 60°C. Vinyl ester was formed in viscous form. The reaction scheme is shown below.

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**2.3 Properties and Applications**

|  |  |  |  |
| --- | --- | --- | --- |
| Property | Bisphenol-A\* | Bisphenol-A\* | Novolac |
| Viscosity, cP, 25℃ | 200~700 | 2000~3000 | 300~500 |
| Specific Gravity, 25℃ | 1.04~1.06 | 1.06~1.08 | 1.07~1.09 |
| Gel Time \*a, minutes, 25℃ | 20~30 | 20~30 | 15~25 |
| Co(6%)=0.4% | Co(6%)=0.4% | Co(6%)=0.4% |
| MEKPO=1.6% | MEKPO=1.6% | MEKPO=1.2% |
| Styrene Content, % | 43~47 | 33~37 | 31~35 |
| Stability, Dark at 25℃(month) | 6 | 6 | 3 |

**\****The difference lies in the chemical properties of the two products like viscosity, specific gravity, styrene content etc.*

|  |  |  |
| --- | --- | --- |
| Product Name | Features | Applications |
| Bisphenol-A\* | ■ Low viscosity. | ■ Raw material tanks, pipe and process equipment. |
| ■ Excellent mechanical properties and easy processing. | ■ Most commercial FRP fabrication processes. |
| ■ Excellent corrosion resistance to a wide range of acids, alkalis and salt solutions. | ■ Anti-corrosion tank linings and coatings. |
| ■ Comply with FDA regulation 21 CFR 177.2420 when treated well. | ■ Yacht, Wind turbine blade. |
| ■ Obtained the DNV Type Approval Certificate. |  |
| Bisphenol-A\* | ■ High viscosity (SM=35%). | ■ Fabricating tanks, pipe and process equipment. |
| ■ Excellent mechanical properties and corrosion resistance. |  |
| Novolac | ■ Excellent mechanical properties, good retention of strength and toughness at high temperatures. | ■ High temperature chlorination or caustic scrubbing tower and storage tank. |
| ■ High resistance to solvents and chemicals. | ■ Industrial waste treatment facilities. |
| ■ Excellent resistance to acidic oxidizing environments. | ■ Flue gas desulfurization (FGD) system. |
|  |  | ■ Hydrochloric acid tank truck, organic solvent storage tank and most commercial FRP fabrication processes. |

**\****The difference lies in the chemical properties of the two products like viscosity, specific gravity, styrene content etc.*

**2.4 End of Life and Sustainability**

**Health, Safety & Environment (HSE) :**

Vinyl Ester Resin grades are classified under category 3 of flammable liquids, further these Resins are classified under health hazards in different categories mention below.

|  |  |
| --- | --- |
| Health Hazards | Category |
| Acute toxicity (inhalation: vapour) | Category 4 |
| Skin corrosion/irritation | Category 2 |
| Serious eye damage/eye irritation | Category 2 |
| Germ cell mutagenicity | Category 2 |
| Specific target organ toxicity — single exposure (central nervous system) | Category 1 |
| Specific target organ toxicity — Single exposure | Category 3, (Respiratory  tract irritation) |
| Specific target organ toxicity — Repeated exposure | Category 1 (respiratory system, liver, nervous system, blood) |

*Source: - SHOWA DENKO K.K*

Under Environmental hazards, Vinyl ester resins are classified under category 2 for aquatic environment.

**End of the life**

Vinyl Ester Resin have maximum shell life of around 18 months when stored in a controlled environment as per guidelines issued by manufacturer. The Shell life of the product depends on grade and company to company. For Instance, Derakane™ Signia™ produce by IENOS claim to have a shelf life of 18 months.

**Environment Pollution Index (EPI) Baseline**

|  |  |
| --- | --- |
| **Emission Sources** | **Baseline Emissions (lb/yr)** |
| Resin Finishing | 30 |
| Steam jet Exhausts | 200 |
| Vapor containment from synthesis | 1300 |
| Storage tanks | 1800 |
| Wastewater | 17000 |
| Equipment Leaks | N/A |

The baseline emission varies depending on the capacity of the manufacturing plant, reactants and the product manufactured.

**Carbon Footprint Analysis**

**Life Cycle Assessment (LCA) data for Epoxy Resin**

|  |  |  |  |
| --- | --- | --- | --- |
| **Material** | **EE (MJ/kg)** | **GWP (kg CO2e/kg)** | **Reference** |
|  |
| Epoxy | 76‐137 | 4.7‐8.1 | Bricout et al. (2017) |  |
| Epoxy | 76 |  | Suzuki and Takahashi (2005) |  |
| Epoxy | 137.1 | 8.1 | Plastics Europe (2005) |  |
| Bisphenol‐A | 80.1 | 2.54 | Plastics Europe (2011) |  |
| Epoxy | 77.4 |  | US DoE (2016) |  |
| Epoxy | 76‐80 |  | Song et al. (2009) |  |
| Epoxy | 137.1 | 5.7 | Rankine (2006) (quoting PE) |  |
| EP Curing Agent‐Ethylenediamine | 124.6 | 6.3 | Eu CIA (2014) |  |
| EP Curing Agent‐Phthalic Anhydride | 78.2 | 2.7 | Eu CIA (2014) |  |
| EP Resin | 135 | 6.8 | Eu CIA (2014) |  |

*Source: EPA, European Commission*

**Life Cycle Assessment (LCA) data for Vinyl Ester Resin**

|  |  |  |  |
| --- | --- | --- | --- |
| **Material** | **EE (MJ/kg)** | **GWP (kg CO2e/kg)** | **Reference** |
|  |
| VE Resin (BPA epoxy based) | 121.5 | 5.97 | Eu CIA |  |
| Bisphenol‐A VE | 119.3 | 5.87 | Rietveld and Hegger (2014) |  |

*Source: EPA, European Commission*

The Global Warming Potential (GWP) compares the global warming impacts of different gases. In simple terms, it is a measure of how much energy the emissions of 1 ton of a gas will absorb over a given period of time, relative to the emissions of 1 ton of carbon dioxide. The larger the GWP, the more the given gas warms the Earth as compared to CO2 over that time period. The time period usually for GWPs is 100 years.

Carbon dioxide, by definition, has a GWP of 1 regardless of the time period used, as it is the gas being used as the reference. Methane (CH4) is estimated to have a GWP of 25-36 over 100 years. CH4 emitted today lasts about a decade on an average, which is much less time than CO2. But CH4 absorbs much more energy than CO2.

|  |  |
| --- | --- |
| **Greenhouse Gas** | **Global Warming Potential (GWP)** |
| 1. Carbon dioxide (CO2) | 1 |
| 2. Methane (CH4) | 25 |
| 3. Nitrous Oxide (N2O) | 298 |
| 4. Hydrofluorocarbons (HFCs) | 124-14,800 |
| 5. Perfluorocarbons (PFCs) | 7,390 – 12,200 |
| 6. Sulphur hexafluoride (SF6) | 22,800 |
| 7. Nitrogen trifluoride (NF3) | 17,200 |

*Source: EPA, European Commission*

*The “global warming potential” (or “GWP”) of a GHG indicates the amount of warming a gas cause over a given period (normally 100 years). GWP is an index, with CO2 having the index value of 1, and the GWP for all other GHGs is the number of times more warming they cause compared to CO2. E.g., 1kg of methane causes 25 times more warming over a 100-year period compared to 1kg of CO2, and so methane as a GWP of 25.*

**Key Implications**

* As per emission average observed at domestic as well as overseas facility, the production of 1 Kg vinyl ester resin is estimated to record GWP of around 6 implying a fair degree of GHG emissions and substantial amount of heat retention.
* This can be mitigated by, as per industry experts, different types of wet scrubbers where its installation is estimated to incur XX% of equipment cost and periodic rate of consumables replenishment suggested by service provider.
* Alternatively, hazardous air pollutant (HAP) has been noted as a major emission, which is being addressed by reduction of styrene content by weight to 20%.

**3. Market Outlook and Relevance of the Project**

**3.1. Demand Supply Outlook – Global Vinyl Ester Resin Market**

**Global Vinyl Ester Resin Demand-Supply Scenario, 2015-2030F (Thousand Tonnes)**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Parameters** | **2015** | **2020** | **2021E** | **2025F** | **2030F** |
| **Total Installed Capacity** | 938 | 985 | 1020 | 1025 | 1030 |
| **Total Production** | 733 | 759 | 808 | 866 | 929 |
| **Total Demand/Consumption** | 677 | 739 | 789 | 1026 | 1367 |
| **Total Demand (Y-O-Y Growth Rate, %)** | 3.87% | -7.14% | 6.71% | 6.42% | 5.58% |
| **Demand – Supply Gap** | 0.00 | 0.00 | 19.23 | -159.81 | -438.76 |

* Demand has increased after the slump of 2020, where downstream sectors have increased consumption in the wake of economic recovery. A trend has been witnessed where the companies having captive market have gained improved margins while others have witnessed a cutback in margins due to uneven price assessments of raw materials. Demand from the marine and renewables sector has shown an upward trend contributing to the increase in demand in 2021.
* APAC and North America region accounted for the largest share in the global vinyl ester resin based FRP composites market in 2020 and 1st half of 2021 and trend is expected to remain same during forecast period as well. The aerospace industries in the USA and Mobile Manufacturing units in North-East Asia are the largest consumers in the world and is emanating high demand for composites for manufacturing fighter aircraft, airplanes, LCD panels and their components.

*Source: TechSci Research*

**Global Vinyl Ester Resin Demand, By Volume (Thousand Tonnes), 2015–2030F**

**2015-2020**

**CAGR**

**1.77% By Volume**

*Source: TechSci Research*

* The betterment of supply chain management and rising demand from various end user industries contributed to the increasing market for vinyl ester resin.
* Companies have been noticing the rise in their revenue quarterly, especially through vinyl ester resin. INEOS Group and Hexion Inc. both witnessed the increase in revenues by 26% and 13%, respectively from Q1 2021 to Q2 2021.
* The Increase in demand is led by strong demand for excellent chemical and thermal resistant material in downstream applications such as semiconductor encapsulation, electronics and communication, construction, and automobile industries.

The Increase in demand is led by strong demand for excellent chemical and thermal resistant material in downstream applications such as semiconductor encapsulation, electronics and communication, construction, and automobile industries

**3.1.1. Capacity By Company**

**Global Vinyl Ester Resin Capacity, By Company (Thousand Tonnes), 2015-2030F**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Company | Capacity | | | | | |
| Location | 2015 | 2020 | 2021E | 2025F | 2030F |
| AOC Resins | China | 70.0 | 70.0 | 70.0 | 70.0 | 70.0 |
| Switzerland | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 |
| USA | 60.0 | 70.0 | 70.0 | 70.0 | 70.0 |
| INEOS Composites | China | 50.0 | 50.0 | 50.0 | 50.0 | 50.0 |
| Germany | 0.0 | 30.0 | 30.0 | 30.0 | 30.0 |
| USA | 50.0 | 85.0 | 85.0 | 85.0 | 85.0 |
| Swancor Holding Co., LTD. | Taiwan | 60.0 | 70.0 | 70.0 | 70.0 | 70.0 |
| Showa Denko K.K. | China | 20.0 | 20.0 | 50.0 | 50.0 | 50.0 |
| Japan | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 |
| Singapore | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 |
| Scott Bader Company Ltd. | France | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 |
| United Kingdom | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 |
| United Arab Emirates | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 |
| Polynt-Reichhold | India | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 |
| Italy | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 |
| USA | 35.0 | 35.0 | 35.0 | 35.0 | 35.0 |
| Eternal Materials Co.,Ltd. | China | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 |
| Taiwan | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 |
| Malaysia | 10.0 | 15.0 | 15.0 | 15.0 | 15.0 |
| Sino Polymer | China | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 |
| Italy | 18.0 | 18.0 | 18.0 | 18.0 | 18.0 |
| Hexion Inc. | Netherlands | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 |
| DIC Corporation | Japan | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 |
| Poliya | Russia | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 |
| Turkey | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 |
| Saudi Arabia Industrial Resins Ltd. | Saudi Arabia | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 |
| Reinhold GmbH | Germany | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 |
| Interplastic Corporation | USA | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 |
| Allnex group | Germany | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 |
| En Chuan Chemical Industries Co., Ltd. | Taiwan | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 |
| Sewon Chemical | South Korea | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |
| Innovative Resins Pvt. Ltd. | India | 1.8 | 1.8 | 1.8 | 1.8 | 1.8 |
| Orson Chemicals | India | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 |
| Satyen Polymers Pvt. Ltd. | India | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 |
| Crystic Resins India Private Limited | India | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 |
| Mechemco resins pvt ltd | India | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 |
| Moras Chemicals India Pvt. Ltd. | India | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 |
| Ashland Global Holdings Inc. | Germany | 25.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| USA | 30.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Others |  | 172.3 | 184.3 | 189.3 | 194.3 | 199.3 |
| Total |  | 938.1 | 985.1 | 1020.1 | 1025.1 | 1030.1 |

* Major manufacturing company, INEOS Composites acquired the Ashland’s composite business in 2019.
* In 2020, Showa Denko K.K, a Japanese Vinyl Ester Resin producer expanded its VER production line to almost double of its existing capacity through its Chinese subsidiary Shanghai Showa Highpolymer Co., Ltd. (SSHP).
* Also, in 2014 Chinese Vinyl Ester resin market leader Sino Polymer Co. Ltd announced strategic cooperation with Europe’s Nord Composites under which Nord Composites would produce Sino Polymer’s MFE brand of VER in its plant located in Italy.

*Source: TechSci Research*

**Global Investment in Renewable Energy Capacity by Sector in 2019 (USD Billion)**

*Source: UNEP, Frankfurt School-UNEP Centre*

* The increase in production is mainly led by high demand for vinyl ester resin in downstream fiber reinforced plastic (FRP) applications.
* Asia Pacific region holds approximately 44% of the total production capacity, which can be attributed to the presence of major players like Jinling AOC Resins Co., Ltd., Showa Denko K.K., Sino Polymer, INEOS Composites, among others.
* The total production value in 2020 saw a decline of approximately 8% as compared to the 2019 production level. However, approximately 7% growth in production is expected in 2021 due to increasing demand of vinyl ester resin globally.

**Global Advanced Composites\* Market Share, By Region, By Value, 2015 & 2020**

*Source: TechSci Research*

**2015**

**2020**

*Source: TechSci Research*

\**Advanced Composites are lightweight and strong engineered materials consisting of high-performance reinforcing fibers embedded in a toughened polymeric matrix that exhibit high stiffness, or modulus of elasticity characteristics, compared to other materials*

**3.1. 4. Operating Efficiency By Company**

**Global Vinyl Ester Resin Operating Efficiency, By Company, 2015-2030F**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Company | Operating Efficiency (%) | | | | |
| 2015 | 2020 | 2021E | 2025F | 2030F |
| AOC Resins | 87 | 81 | 80 | 91 | 96 |
| INEOS Composites | 29 | 49 | 49 | 54 | 59 |
| Swancor Holding Co., LTD. | 73 | 80 | 84 | 90 | 96 |
| Showa Denko K.K. | 79 | 82 | 84 | 88 | 95 |
| Scott Bader Company Ltd. | 82 | 82 | 84 | 86 | 91 |
| Polynt-Reichhold | 81 | 80 | 80 | 85 | 86 |
| Eternal Materials Co.,Ltd. | 77 | 76 | 79 | 86 | 93 |
| Sino Polymer | 80 | 77 | 81 | 84 | 88 |
| Poliya | 85 | 85 | 86 | 89 | 93 |
| Hexion Inc. | 79 | 80 | 83 | 84 | 85 |
| DIC Corporation | 75 | 79 | 82 | 86 | 91 |
| Saudi Arabia Industrial Resins Ltd. | 76 | 78 | 86 | 89 | 97 |
| Reinhold GmbH | 77 | 74 | 78 | 82 | 90 |
| Interplastic Corporation | 75 | 72 | 71 | 77 | 78 |
| Allnex group | 75 | 72 | 73 | 80 | 90 |
| En Chuan Chemical Industries Co., Ltd. | 72 | 73 | 77 | 87 | 93 |
| SEWON CHEMICAL | 81 | 84 | 87 | 92 | 96 |
| Innovative Resins Pvt. Ltd. | 76 | 80 | 74 | 84 | 91 |
| Orson Chemicals | 78 | 82 | 76 | 86 | 93 |
| Satyen Polymers Pvt. Ltd. | 77 | 81 | 71 | 79 | 92 |
| Crystic Resins India Private Limited | 74 | 79 | 68 | 77 | 90 |
| Mechemco resins pvt ltd | 73 | 76 | 80 | 90 | 95 |
| Moras Chemicals India Pvt. Ltd. | 88 | 79 | 83 | 86 | 93 |
| Ashland Global Holdings Inc. | 81 | 0 | 0 | 0 | 0 |

*Source: TechSci Research*

* Globally, companies are producing at high operating rates in 2021 than last year due to increasing demand of FRP coating and lining from the pipes & tanks industry, construction sector and marine industry.
* Moreover, rising investment in the defense sector by major economies drove the companies to operate at higher efficiency.
* Other factors supporting operating rates are increasing investment in renewable energy sources like wind and solar energy in emerging economies in the Asia Pacific.

**3.1.5. Demand By Application**

**Global Vinyl Ester Resin Demand, By Application, By Volume (000’ Tonnes) (%), 2015–2030F**

*Others include Défense, Aerospace, Electrical and electronics etc.*

*Source: TechSci Research*

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Demand by Application** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** | **2021E** | **2025F** | **2030F** |
| Pipes & Tanks | 399 | 417 | 433 | 452 | 469 | 437 | 466 | 609 | 818 |
| Marine Components | 128 | 135 | 140 | 147 | 153 | 142 | 155 | 197 | 270 |
| Renewables | 43 | 45 | 47 | 49 | 51 | 48 | 51 | 66 | 89 |
| Others | 108 | 111 | 115 | 119 | 123 | 112 | 118 | 154 | 190 |
| **Total** | **677** | **708** | **735** | **767** | **796** | **739** | **789** | **1026** | **1367** |

*Others include Défense, Aerospace, Electrical and electronics etc.*

*Source: TechSci Research*

**3.1.6. Demand By Type**

**Global Vinyl Ester Resin Demand, By Type, By Volume (000’ Tonnes) (%), 2015–2030F**

*Others include Urethane Modified vinyl ester resin, Elastomer Modified vinyl ester resin etc.*

*Source: TechSci Research*

**Regional Segmentation of Bisphenol A, F & S Consumption for Vinyl Ester Resin Production (2021)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Region/ Country** | **Bisphenol A** | **Bisphenol F** | **Bisphenol S** |
| **India** | 92% | 5% | 3% |
| **APAC** | 88% | 9% | 4% |
| **Europe** | 81% | 15% | 4% |
| **North America** | 83% | 12% | 5% |
| **South America** | 94% | 4% | 2% |
| **Middle East and Africa** | 86% | 10% | 4% |

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Demand by Type** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** | **2021E** | **2025F** | **2030F** |
| Bisphenol-A, F,S vinyl ester resin | 351 | 365 | 379 | 398 | 412 | 383 | 409 | 534 | 715 |
| Novolac vinyl ester resin | 184 | 193 | 201 | 210 | 218 | 203 | 215 | 283 | 380 |
| Brominated vinyl ester resin | 60 | 62 | 63 | 65 | 67 | 64 | 67 | 87 | 114 |
| Other | 83 | 87 | 91 | 94 | 99 | 89 | 97 | 123 | 159 |
| **Total** | **677** | **708** | **735** | **767** | **796** | **739** | **789** | **1026** | **1367** |

*Others include Urethane Modified vinyl ester resin, Elastomer Modified vinyl ester resin etc.*

*Source: TechSci Research*

* The Bisphenol- A type vinyl ester resin contributes to around 50% of the global vinyl ester resin types due to its excellent properties of corrosion resistance to a variety of alkalis, organic and inorganic salts, salt solutions and oxidizing chemicals, etc
* As Bisphenol A has been banned in Europe, the demand for Bisphenol A Vinyl Ester Resin is expected to gradually decrease as Bisphenol A will be replaced by Bisphenol F and S.
* Novolac vinyl ester resin contributes to around 27% which has been specially modified for improved fabrication properties. It provides improved product quality and fabrication efficiency to ens users, which offers extended shelf life and adds improved flexibilty to fabricators.

**Global Vinyl Ester Resin Demand Supply Analysis, By Volume, 2015-2030F (Thousand Tonnes)**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** | **2021E** | **2025F** | **2030F** |
| **Capacity** | 938 | 938 | 953 | 965 | 980 | 985 | 1020 | 1025 | 1030 |
| **Production** | 733 | 750 | 775 | 790 | 812 | 759 | 808 | 866 | 929 |
| **Import** | 125.99 | 122.12 | 117.69 | 114.67 | 121.38 | 105.97 |  | | |
| **Export** | 125.99 | 122.12 | 117.69 | 114.67 | 121.38 | 105.97 |
| **Total Demand** | 677.49 | 707.79 | 734.69 | 767.44 | 796.32 | 739.49 | 789.09 | 1026.25 | 1367.33 |
| **Y-O-Y Growth (%)** | - | 4.47% | 3.80% | 4.46% | 3.76% | -7.14% | 6.71% | 6.42% | 5.58% |
| **Demand Supply Gap** |  | | | | | | 19.23 | -159.81 | -438.76 |

*Source: TechSci Research*

**Global Vinyl Ester Resin Demand, By Volume, 2020-2030F (000’ Tonnes)**

*Source: TechSci Research*

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Demand Scenario** | **2020** | **2021E** | **2022F** | **2023F** | **2024F** | **2025F** | **2026F** | **2027F** | **2028F** | **2029F** | **2030F** |
| Optimistic | 739.49 | 807.80 | 885.74 | 969.34 | 1058.92 | 1153.73 | 1254.68 | 1362.92 | 1477.58 | 1600.04 | 1729.79 |
| Realistic | 739.49 | 789.09 | 845.26 | 903.66 | 964.31 | 1026.25 | 1090.08 | 1156.54 | 1224.57 | 1295.08 | 1367.33 |
| Pessimistic | 739.49 | 766.69 | 798.03 | 828.98 | 859.50 | 888.67 | 917.01 | 945.14 | 972.10 | 998.62 | 1024.07 |

**3.1.7. Demand By Sales Channel**

**Global Vinyl Ester Resin Demand, By Sales Channel, By Volume (000’ Tonnes) (%), 2015–2030F**

*Source: TechSci Research*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Demand by Sales Channel (000’ Tonnes)** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** |
| Direct | 551 | 575 | 599 | 634 | 664 | 616 |
| Indirect | 126 | 132 | 135 | 134 | 132 | 124 |
| Total | **677** | **708** | **735** | **767** | **796** | **739** |

*Source: TechSci Research*

**3.1.8. Demand By Region**

**Global Vinyl Ester Resin Demand, By Region, By Volume (000’ Tonnes), 2021E & 2030F**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Region/Country** | **2015** | **2020** | **2021E** | **2025F** | **2030F** | **CAGR (2015-2020** | **CAGR (2021E-2030F)** |
| Asia Pacific | 283 | 322 | 349 | 485 | 688 | 2.61% | 14.51% |
| India | 9 | 10 | 11 | 17 | 30 | 3.10% | 11.70% |
| China | 131 | 145 | 158 | 224 | 331 | 2.04% | 8.55% |
| Japan | 46 | 47 | 55 | 79 | 123 | 0.60% | 9.48% |
| South Korea | 35 | 41 | 46 | 67 | 98 | 2.96% | 8.85% |
| Others | 63 | 79 | 80 | 98 | 106 | 4.85% | 3.19% |
| Global APAC (Percentage Share) | 41.82% | 43.58% | 44.29% | 47.24% | 50.33% |  |  |
| Europe | 171 | 178 | 187 | 229 | 282 | 0.75% | 8.55% |
| Germany | 33 | 35 | 37 | 46 | 58 | 1.04% | 5.21% |
| France | 16 | 16 | 16 | 18 | 23 | 0.44% | 4.84% |
| United Kingdom | 18 | 17 | 18 | 20 | 25 | -0.89% | 3.76% |
| Others | 104 | 110 | 116 | 144 | 175 | 2.17% | 5.02% |
| Global Europe (Percentage Share) | 25.25% | 24.02% | 23.71% | 22.27% | 20.62% |  |  |
| North America | 153 | 164 | 173 | 215 | 275 | 1.40% | 9.74% |
| USA | 140 | 148 | 157 | 198 | 257 | 1.22% | 5.58% |
| Canada | 6 | 7 | 7 | 9 | 12 | 1.55% | 6.48% |
| Mexico | 7 | 9 | 8 | 7 | 6 | 4.59% | -3.70% |
| Global North America (Percentage Share) | 22.52% | 22.11% | 21.89% | 20.93% | 20.10% |  |  |
| South America | 20 | 20 | 21 | 25 | 31 | 0.67% | 7.90% |
| Brazil | 12 | 12 | 13 | 16 | 20 | 0.84% | 4.72% |
| Argentina | 1 | 1 | 1 | 1 | 1 | 5.21% | 2.65% |
| Others | 7 | 7 | 7 | 8 | 10 | -0.22% | 3.75% |
| Global South America (Percentage Share) | 2.90% | 2.74% | 2.65% | 2.43% | 2.24% |  |  |
| Middle East and Africa | 51 | 56 | 59 | 73 | 92 | 1.86% | 9.28% |
| Saudi Arabia | 17 | 20 | 21 | 23 | 29 | 2.55% | 3.60% |
| Others | 34 | 36 | 38 | 50 | 63 | 1.49% | 5.80% |
| Global MEA (Percentage Share) | 7.51% | 7.54% | 7.46% | 7.13% | 6.71% |  |  |

* With the countries moving towards more and more sustainable energy solutions, the demand for wind energy is expected to grow exponentially in the Asia Pacific during the forecast period, hence the region will keep the dominating share in the global market.

**3.1.9. Sales By Company**

**Global Vinyl Ester Resin Sales, By Company, By Volume (000’ Tonnes) (%), 2020**

*Others include Poliya, Hexion Inc., DIC Corporation, Saudi Arabia Industrial Resins Ltd.., Reinhold GmbH, Interplastic Corporatio, Allnex Group, Sewon Chemical, Innovative Resins Pvt. Ltd., Orson Chemicals etc.*

*Source: TechSci Research*

* AOC is leading the market, followed by INEOS Composites and Swancor Holding Co., Ltd.
* AOC, the leader in composites market, has been able to bring novel styrene free resins to commercial sales in the last twenty years and has also partnered with various companies to develop out of the box solutions which may bring both sustainability and performance.
* INEOS Composites provides high quality vinyl ester products such as AME™, Arotran™, Derakane™, Derakane™ Signia™, Hetron™.
* Most of the Indian companies such as Mechemco resins Pvt Ltd., Innovative Resins Pvt. Ltd. etc. manufacture vinyl ester of INEOS’s vinyl ester quality. The major drivers identified for their growth are robust supply chain management clubbed with proposed expansion plans for upcoming Vinyl Ester Resin manufacturing facilities.

Background pattern

Description automatically generated

**ASIA PACIFIC VINYL ESTER RESIN DEMAND SUPPLY OUTLOOK**



**Asia Pacific Vinyl Ester Resin Capacity & Production (000’ Tonnes), 2015-2030F**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Company | Location | 2015 | 2020 | 2030F |
| Jinling AOC Resins Co., Ltd. | China | 70 | 70 | 70 |
| Swancor Holding Co., LTD. | Taiwan | 60 | 70 | 70 |
| INEOS Composites | China | 40 | 40 | 40 |
| DIC Corporation | Japan | 30 | 30 | 30 |
| Sino Polymer | China | 20 | 20 | 20 |
| Others | Rest of APAC | 207 | 212 | 257 |
| Total |  | 427 | 442 | 487 |

*Source: TechSci Research*

**3.2.1. Asia Pacific Demand Supply Outlook**

**Asia Pacific Vinyl Ester Resin Demand, By Volume (000’ Tonnes), 2015–2030F**

*Source: TechSci Research*

**2021E-2030F**

**CAGR**

**7.82% By Volume**

**2015-2020**

**CAGR**

**2.61% By Volume**

* Exports are higher than imports due to the presence of major vinyl ester resin producers in the region.
* Total export in 2020 stood at around 23 thousand tonnes while imports stood at around 24 thousand tonnes. Increasing export is attributed to the increasing demand for vinyl ester resin from fiber reinforced plastic (FRP) application in the pipe and tank industry.
* Several manufacturers are investing heavily in capacity expansion to meet the growing demand for vinyl ester resin in the region.

**Electronic, Telecommunication and Renewables sector have high latent demand in APAC region:**

* Increasing market of electronic parts due to development in telecommunication technologies as well as 5G revolution in mobile application has led to increase in consumption of LCD and touch panels leading to increasing demand of Vinyl ester resin.
* Vinyl ester resin is used as inner lining material in electronic items due to its excellent corrosion and chemical resistance properties.
* Vinyl ester resin has also application in semiconductor and chip encapsulation due to its heat resistance properties. Growth of display panel market has augmented the demand of display driver chips.
* As per CINNO survey, APAC demand of display driver chips in 2020 is valued around 6 billion which is 8.7% rise from 2019 value. Moreover, demand for smartphone driver chips valued around 1.2 billion in 2020.

**LCD Smartphone display driver chips vendor shipment share, 2020**

*Source: CINNO*

**Renewable energy Consumption in Asia-Pacific region in 2020, By Country (In exajoules)**

China holds largest share of renewable energy consumption in Asia Pacific region led by increasing investments into development of renewable energy. China’s consumption of renewable energy is approximately 8 exajoules in 2020. India and Japan are also significantly increasing investments into building energy infrastructure such as solar energy and wind energy.

*Source: IRENA*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Approach: Growth Forecast Via Factors (Impact Analysis)** | | | | |
| **Factors** | **Sources** | **Value** | **CAGR** | **Weightage** |
| **GDP Growth Rate (2021-2030 Period)** | ***World Bank, IMF, TechSci Estimates*** | ***Forecast*** | 6.12% | 15.00% |
| **GDP Per Capita (%)** | ***World Bank, IMF, TechSci Estimates*** | ***Forecast*** | 4.12% | 4.00% |
| **Average Selling Growth (%)** | ***TechSci Research Estimates*** | ***Forecast*** | 3.56% | 4.00% |
| **Growth in Construction\* Sector** | ***TechSci Research Estimates*** | ***Forecast*** | 8.46% | 28.00% |
| **Growth in Renewable Sector** | ***TechSci Research Estimates*** | ***Forecast*** | 7.00% | 18.00% |
| **Growth in Marine Components** | ***Industry Sources & TechSci Research Estimates*** | ***Forecast*** | 11.22% | 25.00% |
| **Market Growth in Historical Period (2015-2020)** | ***Industry Sources & TechSci Research Estimates*** | ***Historical*** | 2.61% | 6.00% |
| **CAGR (2021-2030)** | **7.82%** | | | |

\*Mainly the Pipes & Tanks going in Industrial and manufacturing sector.

TechSci Research has followed this approach to calculate the growth rates by understanding the impact of various factors of the industry. These factors were given weightage according to the relative importance of each factor. Finally, each factor was multiplied with its weightage and their sum was used to calculate market growth.

**3.2.1.2. Operating Efficiency**

**Asia Pacific Vinyl Ester Resin Operating Efficiency (Percentage), 2015-2030F**

**Real GDP Growth Forecast for Major Economies in APAC Region**

|  |  |  |
| --- | --- | --- |
| **Country** | **2023** | **2025** |
| India | 7.67% | 7.42% |
| China | 5.75% | 5.60% |
| Japan | 1.26% | 0.72% |
| South Korea | 2.45% | 3.44% |
| World | 3.84% | 3.56% |

*Source: IMF, World Bank*

**3.2.1.3. Demand By Application**

**Asia Pacific Vinyl Ester Resin Demand, By Application, By Volume (000’ Tonnes) (%), 2015–2030F**

*Others include Défense, Aerospace, Electrical and electronics etc.*

*Source: TechSci Research*

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Demand by Application** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** | **2021E** | **2025F** | **2030F** |
| Pipes & Tanks | 167 | 178 | 187 | 196 | 206 | 192 | 207 | 289 | 414 |
| Marine Components | 57 | 61 | 64 | 68 | 72 | 66 | 74 | 97 | 145 |
| Renewables | 19 | 20 | 21 | 23 | 23 | 22 | 24 | 33 | 47 |
| Others | 40 | 42 | 45 | 46 | 48 | 42 | 44 | 66 | 82 |
| **Total** | **283** | **301** | **317** | **333** | **349** | **322** | **349** | **485** | **688** |

*Others include Défense, Aerospace, Electrical and electronics etc.*

*Source: TechSci Research*

* Vinyl Ester Resin market in the APAC region has been dominated by construction sector as demand for pipes and tanks remained robust in the region catering to increase in consumption from infrastructure development and residential buildings. This trend is likely to be continued during the forecasted period as construction sector is expected to lead the demand growth.
* In the APAC region, rising demand for portable water and expansion of piped water will continue to pressure demand for pipes and tanks, however degrading water quality and arrival of water treatment plants have mandated the use of vinyl ester resins in pipes and tanks manufacturing because of its good corrosion resistant and abrasion resistant qualities.
* Furthermore, Indian government’s flagship program “Har Nal se Jal” under which government has envisioned to provide drinking water connections to every rural household by 2024 will augment for demand prospects in the region.
* APAC region is in line with its renewable energy targets as per Paris Agreement and is likely to build upon the available renewables, however uncertainties regarding current circumstances have forced countries to take more calculative and realistic approach which may impact the market prospects of renewables.

**3.2.1.4. Demand By Type**

**Asia Pacific Vinyl Ester Resin Demand, By Type, By Volume (000’ Tonnes) (%), 2015–2030F**

*Others include Urethane Modified vinyl ester resin, Elastomer Modified vinyl ester resin, etc.*

*Source: TechSci Research*

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Demand by Type** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** | **2021E** | **2025F** | **2030F** |
| Bisphenol-A,F,S vinyl ester resin\* | 146 | 156 | 164 | 173 | 180 | 167 | 181 | 252 | 360 |
| Novolac vinyl ester resin | 79 | 85 | 89 | 94 | 98 | 91 | 98 | 137 | 194 |
| Brominated vinyl ester resin | 23 | 24 | 25 | 26 | 28 | 26 | 28 | 39 | 55 |
| Other chemistry | 35 | 36 | 39 | 40 | 43 | 38 | 42 | 57 | 79 |
| **Total** | **283** | **301** | **317** | **333** | **349** | **322** | **349** | **485** | **688** |

*Others include Urethane Modified vinyl ester resin, Elastomer Modified vinyl ester resin, etc.*

*Source: TechSci Research*

*\*Note: In 2020, the percentage distribution of Bisphenol- A, F and S in Asia Pacific was 88%, 9% and 4%, respectively.*

**Asia Pacific Vinyl Ester Resin Demand Supply Analysis, By Volume, 2015-2030F (Thousand Tonnes)**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** | **2021E** | **2025F** | **2030F** |
| **Asia Pacific** | **Capacity** | 427 | 427 | 427 | 427 | 442 | 442 | 477 | 482 | 487 |
| **Production** | 315 | 326 | 337 | 340 | 357 | 327 | 369 | 399 | 441 |
| **Total Demand** | 283.31 | 301.03 | 317.07 | 332.53 | 348.58 | 322.29 | 349.49 | 484.81 | 688.20 |
| **Y-O-Y Growth (%)** | - | 6.26% | 5.33% | 4.88% | 4.83% | -7.54% | 8.44% | 8.06% | 6.84% |
| **Demand Supply Gap** | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 27.90 | -32.22  *Source: TechSci Research* | -102.63 |

**3.2.1.5. Demand By Sales Channel**

**Asia Pacific Vinyl Ester Resin Demand, By Sales Channel, By Volume (000’ Tonnes) (%), 2015–2020**

*Source: TechSci Research*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Demand by Sales Channel** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** |
| Direct | 232 | 247 | 261 | 283 | 302 | 278 |
| Indirect | 51 | 54 | 56 | 50 | 47 | 44 |
| **Total** | **283** | **301** | **317** | **333** | **349** | **322** |

*Source: TechSci Research*

**3.2.1.6. Sales By Company**

**Asia Pacific Vinyl Ester Resin Sales, By Company, By Volume (000’ Tonnes), 2020**

*Others include DIC Corporation, Sino Polymer, Innovative Resins Pvt. Ltd., Orson Chemicals, Reichhold India Pvt. Ltd. etc.*

*Source: TechSci Research*

* Swancor Holding and Jinling AOC are the major manufacturers in the APAC region with the combined market share of close to one-third in terms of sales.
* AOC, globally, has been a key producer of specialty resins and collaboration with China based Jinling has enhanced the VER market prospects in the region.
* With construction sector and electrical & electronics sector are likely to lead demand growth in the region, market participants are expected to consolidate on the market prospects.
* Taiwan headquartered Swancor Holding has observed improved performance in the last two quarters after a lackluster 2020.
* INEOS Composites, a US based company, also cater to the market demand in Asia Pacific countries with several manufacturing units in China.

**Asia Pacific Market Insights**

VER is classified as highly versatile resin, and its market is growing tremendously due to healthy demand growth across several downstream sectors. The demand for VER grew at a CAGR of 2.61% between 2015-2020 and is expected to register a CAGR of 7.82% by volume between 2021-2030. As per our estimates, VER industry operating rate in Asia stands around 77.21% in the current year. Strong projections of GDP growth in several Asian countries will propel the market growth in the coming years, with India leading among several Asian countries.

Based on application, the APAC VER market has been segmented into pipes and tanks, marine composites, renewables and others, with pipes & tanks holding more than 59% share in the overall demand, followed by marine composites. This is largely attributed to rising demand for portable water and expansion of piped water from the agricultural sector.

Based on Type, Bisphenol A, F, S based VER dominates the Asian market, holding more than 50% share followed by Novolac VER. Strong demand share of BPA-based VER is attributed to their versatile chemical applications and their high corrosion resistance.



**EUROPE**

**VINYL ESTER RESIN DEMAND SUPPLY OUTLOOK**



**Europe Vinyl Ester Resin Capacity & Production, By Volume, 2015 - 2030F (000’ Tonnes)**

*Source: TechSci Research*

|  |  |  |  |
| --- | --- | --- | --- |
| Company | 2015 | 2020 | 2030F |
| INEOS Composites | 0 | 30 | 30 |
| Hexion Inc. | 30 | 30 | 30 |
| Allnex group | 20 | 20 | 20 |
| Reinhold GmbH | 20 | 20 | 20 |
| Scott Bader Company Ltd. | 20 | 20 | 20 |
| Others | 118 | 93 | 93 |
| Total | 208 | 213 | 213 |

*Source: TechSci Research*

**3.2.3. Europe Vinyl Ester Resin Demand Supply Outlook**

**Europe Vinyl Ester Resin Demand, By Volume (000’ Tonnes), 2015–2030F**

**2021E-2030F**

**CAGR**

**4.66% By Volume**

**2015-2020**

**CAGR**

**0.75% By Volume**

*Source: TechSci Research*

* Substantial increase in wind energy installation, marine components production and defense project allocation coupled with stable lending rate is contributing to the rapid growth in the sales of vinyl ester resin in Europe.
* Product availability, flexibility and convenience are the major factors propelling the demand. Furthermore, with technological advancements, and product innovations is also continuously increasing. Moreover, manufacturers are rapidly innovating their products with an aim of providing multi-functional features.
* Merger & acquisition activities are becoming prevalent in the market in Europe. For Instance, in 2019, INEOS Composite completed the acquisition of the Ashland Composites polymer business. The company sells the product under the brand name of Derakane, Hetron, Arotran and Signia.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Approach: Growth Forecast Via Factors (Impact Analysis)** | | | | |
| **Factors** | **Sources** | **Value** | **CAGR** | **Weightage** |
| **GDP Growth Rate (2021-2030 Period)** | ***OECD, IMF, TechSci Estimates*** | ***Forecast*** | 3.92% | 10.00% |
| **GDP Per Capita (%)** | ***OECD, IMF, TechSci Estimates*** | ***Forecast*** | 3.22% | 4.00% |
| **Average Selling Growth (%)** | ***TechSci Research Estimates*** | ***Forecast*** | 3.28% | 10.00% |
| **Growth in Construction\* Sector** | ***TechSci Research Estimates*** | ***Forecast*** | 6.58% | 25.00% |
| **Growth in Renewable Sector** | ***TechSci Research Estimates*** | ***Forecast*** | 4.55% | 30.00% |
| **Growth in Marine Components** | ***Industry Sources & TechSci Research Estimates*** | ***Forecast*** | 5.01% | 15.00% |
| **Market Growth in Historical Period (2015-2020)** | ***Industry Sources & TechSci Research Estimates*** | ***Historical*** | 0.75% | 6.00% |
| **CAGR (2021-2030)** | **4.66%** | | | |

\*Mainly the Pipes & Tanks going in Industrial and manufacturing sector.

TechSci Research has followed this approach to calculate the growth rates by understanding the impact of various factors of the industry. These factors were given weightage according to the relative importance of each factor. Finally, each factor was multiplied with its weightage and their sum was used to calculate market growth.

**3.2.3.2. Operating Efficiency**

**Europe Vinyl Ester Resin Operating Efficiency (Percentage), 2015-2030F**

**3.2.3.3. Demand By Application**

*Source: TechSci Research*

**Europe Vinyl Ester Resin Demand, By Application, By Volume (000’ Tonnes) (%), 2015–2030F**

*Others include Défense, Aerospace, Electrical and electronics etc.*

*Source: TechSci Research*

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Demand by Application** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** | **2021E** | **2025F** | **2030F** |
| Pipes & Tanks | 100 | 103 | 105 | 109 | 111 | 104 | 110 | 134 | 166 |
| Marine Components | 29 | 30 | 30 | 31 | 32 | 30 | 32 | 39 | 48 |
| Renewables | 10 | 10 | 10 | 11 | 11 | 10 | 11 | 13 | 16 |
| Others | 32 | 33 | 35 | 35 | 36 | 34 | 34 | 43 | 52 |
| **Total** | **171** | **176** | **180** | **186** | **190** | **178** | **187** | **229** | **282** |

*Others include Défense, Aerospace, Electrical and electronics etc.*

*Source: TechSci Research*

**3.2.3.4. Demand By Type**

**Europe Vinyl Ester Resin Demand, By Type, By Volume (000’ Tonnes) (%), 2015–2030F**

*Others include Urethane Modified vinyl ester resin, Elastomer Modified vinyl ester resin etc.*

*Source: TechSci Research*

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Demand by Type** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** | **2021E** | **2025F** | **2030F** |
| Bisphenol-A,F,S vinyl ester resin | 91 | 93 | 96 | 100 | 101 | 94 | 100 | 122 | 150 |
| Novolac vinyl ester resin | 47 | 49 | 50 | 51 | 52 | 49 | 51 | 62 | 78 |
| Brominated vinyl ester resin | 16 | 16 | 16 | 16 | 16 | 16 | 17 | 20 | 24 |
| Other chemistry | 17 | 18 | 18 | 19 | 21 | 18 | 20 | 24 | 29 |
| **Total** | **171** | **176** | **180** | **186** | **190** | **178** | **187** | **229** | **282** |

*Others include Urethane Modified vinyl ester resin, Elastomer Modified vinyl ester resin etc.*

*Source: TechSci Research*

*\*Note: In 2020, the percentage distribution of Bisphenol- A, F and S in Europe was 81%, 15% and 4%, respectively.*

**Europe Vinyl Ester Resin Demand Supply Analysis, By Volume, 2015-2030F (Thousand Tonnes)**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** | **2021E** | **2025F** | **2030F** |
| **Europe** | **Capacity** | 208 | 208 | 208 | 208 | 208 | 213 | 213 | 213 | 213 |
| **Production** | 169.60 | 172.07 | 172.40 | 172.50 | 174.49 | 169.95 | 176.39 | 181.09 | 189.61 |
| **Total Demand** | 171.09 | 175.88 | 179.66 | 185.58 | 189.85 | 177.60 | 187.10 | 228.54 | 281.95 |
| **Y-O-Y Growth (%)** | - | 2.80% | 2.15% | 3.30% | 2.30% | -6.45% | 5.35% | 4.72% | 3.86% |
| **Demand Supply Gap** | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -10.70 | -47.45 | -92.34 |

*Source: TechSci Research*

**3.2.3.5. Demand By Sales Channel**

**Europe Vinyl Ester Resin Demand, By Sales Channel, By Volume (000’ Tonnes), 2015–2020**

*Source: TechSci Research*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Demand by Sales Channel (000’ Tonnes)** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** |
| Direct | 140 | 144 | 148 | 152 | 156 | 146 |
| Indirect | 31 | 32 | 32 | 34 | 34 | 32 |
| **Total** | **171** | **176** | **180** | **186** | **190** | **178** |

*Source: TechSci Research*

**3.2.3.6. Sales By Company**

**Europe Vinyl Ester Resin Sales, By Company, By Volume (000’ Tonnes) (%), 2020**

*Others include Polynt S.p.A., Reinhold GmbH, Ashland Global Holdings Inc., Allnex group, etc.*

*Source: TechSci Research*

**Europe Market Insights**

VER demand in Europe has registered a CAGR of around 0.75% from 2015-2020. It is expected to grow at a substantial pace with a CAGR of 4.66% from 2021-2030 driven by its increasing preference in pipes and marine components owing to the effective chemical and corrosion resistance offered.

European VER market is being controlled by INEOS Composites and Hexion Inc. each having 30KTPA capacity.



**NORTH AMERICA VINYL ESTER RESIN DEMAND SUPPLY OUTLOOK**



**North America Vinyl Ester Resin Capacity & Production, By Volume (000’ Tonnes), 2015 - 2030F (Thousand Tonnes)**

*Source: TechSci Research*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Company** | **Location** | **2015** | **2020** | **2030F** |
| AOC - Aliancys | USA | 60 | 70 | 70 |
| Polynt-Reichhold | USA | 35 | 45 | 45 |
| INEOS Composites | USA | 0 | 35 | 35 |
| Interplastic Corporation | USA | 20 | 20 | 20 |
| Ashland Global Holdings Inc. | USA | 30 | 0 | 0 |
| Others | Rest of North America | 55 | 55 | 55 |
| Total |  | **200** | 225 | 225 |

*Source: TechSci Research*

**Capacity and Production by Company**

The total installed capacity in North America region stood at 225 thousand tonnes in 2020. The key market players in the region are AOC – Aliancys, Polynt-Reichhold, INEOS composites, and Interplastics Corporation. AOC – Aliancys and Polynt-Reichhold together contribute to 51% of the total installed capacities.

In 2019, INEOS composites took complete acquisition of Ashland Global Holdings taking over its 30 thousand tonnes per annum of vinyl ester resin capacity.

The production of vinyl ester resin in 2020 volumed to 181 thousand tonnes, which was lower than its production of 194 thousand tonnes in 2019 due to the subdued operations in the pandemic period.

The increasing demand in the end-user industries is going to propel the companies to produce higher volumes of vinyl ester resin which is expected to rise to 200 thousand tonnes by 2030.

**3.2.4. North America Vinyl Ester Resin Demand Supply Outlook**

**North America Vinyl Ester Resin Demand, By Volume (000’ Tonnes), 2015–2030F**

*Source: TechSci Research*

The vinyl ester resin market in North America has grown at a steady pace in the historical years. However, limitations in the downstream sectors owing to operation halts and lockdown constraints restricted the market growth in 2020 which stood at 164 thousand tonnes.

With revival of infrastructural projects post-COVID19 period and increasing investment in renewables are expected to drive the vinyl ester resin market growth at a quite healthy CAGR of 5.3% by 2030.

Several manufacturers are investing heavily in capacity expansion and new technology development to meet the growing demand for vinyl ester resin in the region.

This increase in demand is attributed to growing infrastructure projects and increasing investment in renewable energy sector.

Several manufacturers are investing heavily in capacity expansion and new technology development to meet the growing demand for vinyl ester resin in the region.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Approach: Growth Forecast Via Factors (Impact Analysis)** | | | | |
| **Factors** | **Sources** | **Value** | **CAGR** | **Weightage** |
| **GDP Growth Rate (2021-2030 Period)** | ***World Bank, IMF, TechSci Estimates*** | ***Forecast*** | 4.70% | 10.00% |
| **GDP Per Capita (%)** | ***World Bank, IMF, TechSci Estimates*** | ***Forecast*** | 3.26% | 2.00% |
| **Average Selling Growth (%)** | ***TechSci Research Estimates*** | ***Forecast*** | 3.20% | 4.00% |
| **Growth in Construction\* Sector** | ***TechSci Research Estimates*** | ***Forecast*** | 6.40% | 22.00% |
| **Growth in Renewable Sector** | ***TechSci Research Estimates*** | ***Forecast*** | 4.00% | 30.00% |
| **Growth in Marine Components** | ***Industry Sources & TechSci Research Estimates*** | ***Forecast*** | 7.03% | 28.00% |
| **Market Growth in Historical Period (2015-2020)** | ***Industry Sources & TechSci Research Estimates*** | ***Historical*** | 1.40% | 4.00% |
| **CAGR (2021-2030)** | **5.30%** | | | |

\*Mainly the Pipes & Tanks going in Industrial and manufacturing sector.

TechSci Research has followed this approach to calculate the growth rates by understanding the impact of various factors of the industry. These factors were given weightage according to the relative importance of each factor. Finally, each factor was multiplied with its weightage and their sum was used to calculate market growth.

**3.2.4.2. Operating Efficiency**

**North America Vinyl Ester Resin Operating Efficiency (Percentage), 2015-2030F**

*Source: TechSci Research*

Majority of the vinyl ester resin producers operate at 84-86% utilization rate. The operating rates declined to 80% in 2020 owing to limited demand and operational constraints due the outbreak of COVID19 pandemic.

With recovering operational activities in 2021 in North America, the companies have regained pace of operating at 86% rate which is expected to further rise to almost 89% in 2030 with rise in epoxy resin demand in the end-user industries.

**3.2.4.3. Demand By Application**

**North America Vinyl Ester Resin Demand, By Application, By Volume (000’ Tonnes) (%), 2015–2030F**

*Others include Défense, Aerospace, Electrical and electronics etc.*

*Source: TechSci Research*

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Demand by Application** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** | **2021E** | **2025F** | **2030F** |
| Pipes & Tanks | 91 | 93 | 96 | 101 | 104 | 97 | 103 | 129 | 167 |
| Marine Components | 31 | 32 | 33 | 34 | 35 | 33 | 35 | 44 | 56 |
| Renewables | 10 | 10 | 10 | 11 | 11 | 10 | 11 | 14 | 18 |
| Others | 21 | 22 | 23 | 23 | 24 | 24 | 24 | 28 | 34 |
| **Total** | **153** | **157** | **162** | **169** | **174** | **164** | **173** | **215** | **275** |

*Others include Défense, Aerospace, Electrical and electronics etc.*

*Source: TechSci Research*

The application of vinyl ester resins in tanks and pipes for corrosion resistance materials and coatings holds the highest demand share rounding to 59.5%. It is widely used to manufacture tanks and vessels in Fiberglass Reinforced Plastics (FRP) coating and lining Industry.

The corrosion resistance ability attracts its application in marine industry that accounts for 20% of the total demand share. Application in Renewables hold 6% market share.

The increasing industrialization will drive the use of vinyl ester resins in tanks and pipes manufacturing which will dominate the vinyl ester resins market by taking an volume share of 167 thousand tonnes in 2030 rising from 97 thousand tonnes in 2020.

**3.2.4.4. Demand By Type**

**North America Vinyl Ester Resin Demand, By Type, By Volume (000’ Tonnes) (%), 2015–2030F**

*Others include Urethane Modified vinyl ester resin, Elastomer Modified vinyl ester resin etc.*

*Source: TechSci Research*

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Demand by Type** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** | **2021E** | **2025F** | **2030F** |
| Bisphenol-A,F,S vinyl ester resin | 77 | 79 | 81 | 85 | 88 | 83 | 87 | 109 | 141 |
| Novolac vinyl ester resin | 38 | 40 | 41 | 43 | 45 | 42 | 45 | 56 | 73 |
| Brominated vinyl ester resin | 15 | 15 | 15 | 16 | 16 | 15 | 16 | 19 | 24 |
| Other | 23 | 23 | 25 | 25 | 25 | 24 | 25 | 31 | 37 |
| **Total** | **153** | **157** | **162** | **169** | **174** | **164** | **173**  *Others include Urethane Modified vinyl ester resin, Elastomer Modified vinyl ester resin etc.*  *Source: TechSci Research* | **215** | **275** |

*\*Note: In 2020, the percentage distribution of Bisphenol- A, F and S in North America was 83%, 12% and 5%, respectively.*

Bisphenol-A,F,S vinyl ester enjoys the highest demand of 50.5% amounting to 83 thousand tonnes in 2020 owing to its corrosion and chemical resistance properties.

Novolac vinyl ester contributes to 25.8% of the total demand in North America due to its excellent bonding and adhesion properties. They are specifically applied in harsh environments due to their high mechanical and thermal stability.

**3.2.4.5. Demand By Sales Channel**

**North America Vinyl Ester Resin Demand, By Sales Channel, By Volume (000’ Tonnes) (%), 2015–2020**

*Source: TechSci Research*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Demand by Sales Channel** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** |
| Direct | 122 | 125 | 129 | 135 | 140 | 130 |
| Indirect | 31 | 32 | 33 | 34 | 34 | 34 |
| **Total** | **153** | **157** | **162** | **169** | **174** | **164** |

*Source: TechSci Research*

Vinyl ester resins manufacturers sell their product in bulk quantities directly to their customers in bulk quantities. Hence direct sales channels contribute to 79.8% of the total sales in this region.

Indirect sales channel of vinyl ester resins come into play in cases where bulk volume is not required and demand for the same is addressed by distributors and agents.

**North America Vinyl Ester Resin Demand Supply Analysis, By Volume, 2015-2030F (Thousand Tonnes)**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** | **2021E** | **2025F** | **2030F** |
| **North America** | **Capacity** | 200.00 | 200.00 | 215.00 | 225.00 | 225.00 | 225.00 | 225.00 | 225.00 | 225.00 |
| **Production** | 169.77 | 170.43 | 182.88 | 192.65 | 194.34 | 181.28 | 179.12 | 197.09 | 200.24 |
| **Total Demand** | 152.59 | 157.31 | 162.11 | 169.14 | 174.44 | 163.53 | 172.74 | 214.79 | 274.88 |
| **Y-O-Y Growth (%)** | - | 3.10% | 3.05% | 4.34% | 3.14% | -6.25% | 5.63% | 5.36% | 4.82% |
| **Demand Supply Gap** | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 6.38 | -17.69 | -74.65 |

*Source: TechSci Research*

**3.2.4.6. Sales By Company**

**North America Vinyl Ester Resin Sales, By Company, By Volume (000’ Tonnes) (%), 2020**

*Source: TechSci Research*

AOC – Aliancys has emerged as the largest player holding a market share of more than 29%.

Polynt-Reichhold, INEOS composites and Interplastics Corporation account for 17%, 14% and 7% market share respectively. Strong sales network is the key reason behind the leading market position of the mentioned players.



**SOUTH AMERICA VINYL ESTER RESIN MARKET**

**OUTLOOK**



**South America Vinyl Ester Resin Capacity & Production, By Volume (000’ Tonnes), 2015 - 2030F**

*Source: TechSci Research*

In South America, as of 2020 the total capacity of vinyl ester stood at about 22 thousand tonnes with production of about 16 thousand tonnes. An increase in production of vinyl ester is estimated in forecasted years as the South American market recovers to its pre pandemic levels of economic activity.

**3.2.5. South America Vinyl Ester Resin Demand Supply Outlook**

**South America Vinyl Ester Resin Demand, By Volume (000’ Tonnes), 2015–2030F**

*Source: TechSci Research*

**2021E-2030F**

**CAGR**

**4.31% By Volume**

**2015-2020**

**CAGR**

**0.67% By Volume**

The South American vinyl ester market grew at an average CAGR of 0.67% in terms of volume during the period 2015-2020 and is forecasted to grow at CAGR of 4.31% by 2030 owing to the increasing infrastructural development, increasing demand of manufacturing corrosion-resistant materials and growing demand of using fibre reinforced plastics for tanks and vessels.

* This increase in demand is led by strong demand growth in fiber reinforced plastics (FRP), marine components and wind energy sector.
* Rising industrialization and urbanization have also contributed to the rising demand of the product in the region.
* The increase in demand in industrial applications where it is used as a lining system for water treatment, air pollution, chemical processing and mineral processing providing resistance from corrosion stimulated the market of vinyl ester resin in the region.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Approach: Growth Forecast Via Factors (Impact Analysis)** | | | | |
| **Factors** | **Sources** | **Value** | **CAGR** | **Weightage** |
| **GDP Growth Rate (2021-2030 Period)** | ***World Bank, IMF, TechSci Estimates*** | ***Forecast*** | 4.25% | 26.00% |
| **GDP Per Capita (%)** | ***World Bank, IMF, TechSci Estimates*** | ***Forecast*** | 3.55% | 10.00% |
| **Average Selling Growth (%)** | ***TechSci Research Estimates*** | ***Forecast*** | 3.12% | 8.00% |
| **Growth in Construction\* Sector** | ***TechSci Research Estimates*** | ***Forecast*** | 6.04% | 16.00% |
| **Growth in Renewable Sector** | ***TechSci Research Estimates*** | ***Forecast*** | 5.00% | 16.00% |
| **Growth in Marine Components** | ***Industry Sources & TechSci Research Estimates*** | ***Forecast*** | 5.13% | 15.00% |
| **Market Growth in Historical Period (2015-2020)** | ***Industry Sources & TechSci Research Estimates*** | ***Historical*** | 0.67% | 9.00% |
| **CAGR (2021-2030)** | **4.31%** | | | |

\*Mainly the Pipes & Tanks going in Industrial and manufacturing sector.

TechSci Research has followed this approach to calculate the growth rates by understanding the impact of various factors of the industry. These factors were given weightage according to the relative importance of each factor. Finally, each factor was multiplied with its weightage and their sum was used to calculate market growth.

**Brazil Renewable Energy Production Percentage Share, By types of Sources in 2020.**

**3.2.5.2. Operating Efficiency**

**South America Vinyl Ester Resin Operating Efficiency (Percentage), 2015-2030F**

*Source: TechSci Research*

There is a gradual increase in operating efficiency of all key manufacturers till 2019. The companies suffered a backlog in production efficiency rates in the year 2020 owing to the pandemic. However, as the South American market recovers to its pre pandemic levels of economic activity, the demand for vinyl ester in general is going to increase significantly showing operating efficiency of more than 70 %

**3.2.5.3. Demand By Application**

**South America Vinyl Ester Resin Demand, By Application, By Volume (000’ Tonnes) (%), 2015–2030F**

*Others include Défense, Aerospace, Electrical and electronics etc.*

*Source: TechSci Research*

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Demand by Application** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** | **2021E** | **2025F** | **2030F** |
| Pipes & Tanks | 12 | 12 | 13 | 13 | 14 | 12 | 13 | 15 | 19 |
| Marine Components | 3 | 3 | 4 | 4 | 4 | 3 | 4 | 4 | 5 |
| Renewables | 1 | 1 | 2 | 2 | 2 | 1 | 1 | 2 | 2 |
| Others | 4 | 4 | 2 | 3 | 2 | 4 | 3 | 4 | 5 |
| **Total** | **20** | **20** | **21** | **22** | **22** | **20** | **21** | **25** | **31** |

*Others include Défense, Aerospace, Electrical and electronics etc.*

*Source: TechSci Research*

Vinyl Ester offers wide range of applications including pipes and tanks, marine components, renewables etc. Over the past several years, pipes and tanks segment holds largest market share in the vinyl ester market at about 60% as of 2020 and is forecasted to hold more than 60% market share by 2030 owing to increasing demand in Chlor-alkali and chemical industry, power generation industry, mining and metal industry, industrial water and wastewater industry, food processing industry, and pulp and paper industry.

**3.2.5.4. Demand By Type**

**South America Vinyl Ester Resin Demand, By Type, By Volume (000’ Tonnes) (%), 2015–2030F**

*Others include Urethane Modified vinyl ester resin, Elastomer Modified vinyl ester resin, etc.*

*Source: TechSci Research*

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Demand by Type** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** | **2021E** | **2025F** | **2030F** |
| Bisphenol-A,F,S vinyl ester resin | 10 | 10 | 10 | 11 | 11 | 10 | 10 | 13 | 16 |
| Novolac vinyl ester resin | 5 | 5 | 5 | 5 | 6 | 5 | 5 | 6 | 8 |
| Brominated vinyl ester resin | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 |
| Other | 3 | 3 | 4 | 4 | 3 | 3 | 4 | 4 | 4 |
| **Total** | **20** | **20** | **21** | **22** | **22** | **20** | **21** | **25** | **31** |

*Others include Urethane Modified vinyl ester resin, Elastomer Modified vinyl ester resin, etc.*

*Source: TechSci Research*

*\*Note: In 2020, the percentage distribution of Bisphenol- A, F and S in South America was 94%, 4% and 2%, respectively.*

Depending on the type, Bisphenol-A,F,S vinyl ester resin holds the largest demand share of about 49% as of 2020. It continues to dominate the market among other categories comprising of Novolac vinyl ester resin, Brominated vinyl ester resin and others which include Urethane Modified vinyl ester resin and Elastomer Modified vinyl ester resin.

**South America Vinyl Ester Resin Demand Supply Analysis, By Volume, 2015-2030F (Thousand Tonnes)**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** | **2021E** | **2025F** | **2030F** |
| **South America** | **Capacity** | 20 | 20 | 20 | 22 | 22 | 22 | 22 | 22 | 22 |
| **Production** | 16 | 17 | 17 | 18 | 19 | 16 | 17 | 18 | 20 |
| **Total Demand** | 20 | 20 | 21 | 22 | 22 | 20 | 21 | 25 | 31 |
| **Y-O-Y Growth (%)** | - | 4.33% | 2.15% | 3.64% | 3.68% | -9.71% | 3.23% | 4.32% | 4.05% |
| **Demand Supply Gap** | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -3.49 | -6.93 | -10.83 |

*Source: TechSci Research*

**3.2.5.5. Demand By Sales Channel**

**South America Vinyl Ester Resin Market Share, By Sales Channel, By Volume (000’ Tonnes) (%), 2015–2020**

*Source: TechSci Research*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Demand by Sales Channel (000’ Tonnes)** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** |
| Direct | 16 | 17 | 17 | 18 | 18 | 16 |
| Indirect | 4 | 3 | 4 | 4 | 4 | 4 |
| **Total** | **20** | **20** | **21** | **22** | **22** | **20** |

*Source: TechSci Research*



**MIDDLE EAST & AFRICA VINYL ESTER RESIN MARKET**

**OUTLOOK**



**Middle East & Africa Vinyl Ester Resin Capacity & Production, By Volume (000’ Tonnes), 2015 - 2030F**

*Source: TechSci Research*

In Middle East, as of 2020 the total capacity of vinyl ester stood at about 83 thousand tonnes with production of about 64 thousand tonnes. An increase in production of vinyl ester is estimated in forecasted years as the market recovers to its pre pandemic levels of economic activity.

**Major Demand Drivers of Vinyl Ester Resin During Forecast Period**

* **Increasing Desalination Construction Projects**

GCC nations have limited water resources due to which these countries rely heavily on desalination plants. Due to growing population, GCC nation plans to construct more desalination projects such as Shuaibah IWPP, Ras Abu Fontas A3 project, etc. Countries such as Saudi Arabia plan to invest USD24.30 billion in desalination projects by 2026. These desalination plants are projected to drive need for FRP pipes and tanks.

* **Smart Cities Development**

A smart city adopts high-end technological infrastructure incorporating comprehensive IT infrastructure, a network of sensors, cameras, wireless devices, and data centers for the effective delivery of essential services such as electricity, water supply, sanitation, etc. The vinyl ester resin manufacturers will benefit from smart city projects. In April 2017, Saudi Arabia announced an investment of USD70 billion for the development of four new “Economic Cities” on the concept of smart cities by 2030, with an aim to diversify its economy from hydrocarbon sector to other commercial sectors.

* **Growth in Infrastructure Projects**

GCC nations are boosting their infrastructure by investing heavily on development of railway, roadways, and seaports. Various metro projects have been initiated across different cities in GCC countries such as Jeddah Metro, Kuwait Metro, Doha Metro, Dubai Metro, etc. Development of railway network is projected to lead to the deployment of overhead railway lines and thus drive demand for unsaturated polyester resin including vinyl ester resin in the GCC region.

**Major Infrastructure and Industrial Projects in GCC Region under Planning or Execution, By Value, By 2020 (USD Million)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Activity | Saudi Arabia | UAE | Kuwait | Qatar | Oman | Bahrain |
| Chemical | 64,916 | 24,809 | 565 | 1,484 | 15,450 | 5,000 |
| Construction | 475,218 | 539,793 | 80,080 | 139,843 | 43,160 | 30,967 |
| Gas | 25,402 | 21,083 | 11,848 | 12,889 | 25,712 | 1,258 |
| Industrial | 28,717 | 8,996 | 250 | 970 | 12,179 | 4,656 |
| Oil | 23,409 | 50,899 | 55,188 | 16,559 | 14,659 | 5,025 |
| Power | 332,305 | 35,055 | 29,019 | 8,785 | 9,039 | 6,148 |
| Transport | 217,569 | 99,226 | 46,876 | 103,083 | 36,506 | 11,050 |
| Water | 36,035 | 6,253 | 8,732 | 16,098 | 6,860 | 1,778 |

**3.2.6. Middle East & Africa Vinyl Ester Resin Demand Supply Outlook**

**Middle East & Africa Vinyl Ester Resin Demand, By Volume (000’ Tonnes), 2015–2030F**

**2021E-2030F**

**CAGR**

**5.05% By Volume**

**2015-2020**

**CAGR**

**1.86% By Volume**

*Source: TechSci Research*

The Middle East vinyl ester market grew at an average CAGR of 1.86% in terms of volume during the period 2015-2020 and is forecasted to grow at CAGR of 5.05% by 2030 owing to rising demand from end user industries.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Approach: Growth Forecast Via Factors (Impact Analysis)** | | | | |
| **Factors** | **Sources** | **Value** | **CAGR** | **Weightage** |
| **GDP Growth Rate (2021-2030 Period)** | ***World Bank, IMF, OECD, TechSci Estimates*** | ***Forecast*** | 4.86% | 25.00% |
| **GDP Per Capita (%)** | ***World Bank, IMF, OECD, TechSci Estimates*** | ***Forecast*** | 4.38% | 10.00% |
| **Average Selling Growth (%)** | ***TechSci Research Estimates*** | ***Forecast*** | 2.51% | 6.00% |
| **Growth in Construction\* Sector** | ***TechSci Research Estimates*** | ***Forecast*** | 6.00% | 18.00% |
| **Growth in Renewable Sector** | ***TechSci Research Estimates*** | ***Forecast*** | 6.50% | 22.00% |
| **Growth in Marine Components** | ***Industry Sources & TechSci Research Estimates*** | ***Forecast*** | 4.00% | 18.00% |
| **Market Growth in Historical Period (2015-2020)** | ***Industry Sources & TechSci Research Estimates*** | ***Historical*** | 1.86% | 1.00% |
| **CAGR (2021-2030)** | **5.05%** | | | |

\*Mainly the Pipes & Tanks going in Industrial and manufacturing sector.

TechSci Research has followed this approach to calculate the growth rates by understanding the impact of various factors of the industry. These factors were given weightage according to the relative importance of each factor. Finally, each factor was multiplied with its weightage and their sum was used to calculate market growth.

**3.2.6.2. Operating Efficiency**

**Middle East & Africa Vinyl Ester Resin Operating Efficiency (Percentage), 2015-2030F**

*Source: TechSci Research*

There is a gradual increase in operating efficiency of all key manufacturers till 2019. The companies suffered a backlog in production efficiency rates in the year 2020 owing to the pandemic. However, post pandemic as the middle east market recovers, the demand for vinyl ester in general is going to increase significantly showing operating efficiency of more than 70 % and forecasted to reach about 90% by 2030.

**3.2.6.3. Demand By Application**

**Figure 45: Middle East & Africa Vinyl Ester Resin Demand, By Application, By Volume (000’ Tonnes) (%), 2015–2030F**

*Others include Défense, Aerospace, Electrical and electronics etc.*

*Source: TechSci Research*

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Demand by Application (000’ Tonnes)** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** | **2021E** | **2025F** | **2030F** |
| Pipes & Tanks | 29 | 30 | 31 | 33 | 35 | 32 | 33 | 42 | 52 |
| Marine Components | 9 | 9 | 9 | 10 | 10 | 10 | 10 | 13 | 16 |
| Renewables | 3 | 3 | 3 | 4 | 4 | 3 | 4 | 4 | 6 |
| Others | 10 | 11 | 12 | 12 | 12 | 11 | 12 | 14 | 18 |
| **Total** | **51** | **53** | **55** | **59** | **61** | **56** | **59** | **73** | **92** |

*Others include Défense, Aerospace, Electrical and electronics etc.*

*Source: TechSci Research*

In Middle East region, vinyl ester finds their major application in pipes and tanks followed by marine components, renewables etc. Pipes and tanks segment holds largest market share in the vinyl ester market at about 56% as of 2020.

**3.2.6.4. Demand By Type**

**Figure 46: Middle East & Africa Vinyl Ester Resin Demand, By Type, By Volume (000’ Tonnes) (%), 2015–2030F**

*Others include Urethane Modified vinyl ester resin, Elastomer Modified vinyl ester resin, etc.*

*Source: TechSci Research*

*Others include Urethane Modified vinyl ester resin, Elastomer Modified vinyl ester resin, etc.*

*Source: TechSci Research*

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Demand by Type** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** | **2021E** | **2025F** | **2030F** |
| Bisphenol-A,F,S vinyl ester resin | 26 | 28 | 28 | 30 | 32 | 29 | 31 | 38 | 49 |
| Novolac vinyl ester resin | 14 | 15 | 16 | 17 | 17 | 16 | 17 | 21 | 27 |
| Brominated vinyl ester resin | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 6 | 8 |
| Other chemistry | 6 | 5 | 6 | 7 | 7 | 6 | 6 | 8 | 8 |
| Total | **51** | **53** | **55** | **59** | **61** | **56** | **59** | **73** | **92** |

*\*Note: In 2020, the percentage distribution of Bisphenol- A, F and S in Middle East & Africa was 86%, 10% and 4%, respectively.*

Depending on the type, Bisphenol-A,F,S vinyl ester resin holds the largest demand share of about 52% as of 2020. It continues to dominate the market among other categories comprising of Novolac vinyl ester resin, Brominated vinyl ester resin and others which include Urethane Modified vinyl ester resin and Elastomer Modified vinyl ester resin.

**Middle East & Africa Vinyl Ester Resin Demand Supply Analysis, By Volume, 2015-2030F (Thousand Tonnes)**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** | **2021E** | **2025F** | **2030F** |
| **Middle East & Africa** | **Capacity** | 83 | 83 | 83 | 83 | 83 | 83 | 83 | 83 | 83 |
| **Production** | 63 | 65 | 66 | 67 | 68 | 64 | 66 | 71 | 78 |
| **Total Demand** | 50.89 | 53.10 | 54.95 | 58.53 | 60.98 | 55.79 | 58.83 | 73.14 | 91.68 |
| **Y-O-Y Growth (%)** | - | 4.33% | 3.49% | 6.51% | 4.20% | -8.51% | 5.45% | 5.05% | 4.42% |
| **Demand Supply Gap\*** |  | | | | | | 7.23 | -1.99 | -13.96 |

*Source: TechSci Research*

* *Demand-Supply Gap is considered for forecast period only.*

**3.2.6.5. Demand By Sales Channel**

**Figure 47: Middle East & Africa Vinyl Ester Resin Demand, By Sales Channel, By Volume (000’ Tonnes) (%), 2015–2020**

*Source: TechSci Research*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Demand by Sales Channel** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** |
| Direct | 41 | 43 | 44 | 47 | 49 | 45 |
| Indirect | 10 | 10 | 11 | 12 | 12 | 11 |
| **Total** | **51** | **53** | **55** | **59** | **61** | **56** |

*Source: TechSci Research*

**3.2.6.6. Sales By Company**

**Figure 48: Middle East & Africa Vinyl Ester Resin Sales, By Company, By Volume (000’ Tonnes), 2020**

*Others include Imports*

*Source: TechSci Research*

**India Demand Supply Scenario**

**India Vinyl Ester Resin Capacity, Production and Demand, By Volume (000’ Tonnes), 2015 - 2030F**

*Source: TechSci Research*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Company (000’ Tonnes) | Location | 2015 | 2020 | 2030F |
| Orson Chemicals | Silvassa | 0.72 | 0.72 | 0.72 |
| Reichhold India Pvt. Ltd. | Maharashtra | 0.36 | 0.36 | 0.36 |
| Moras Chemicals India Pvt. Ltd. | Gujarat | 0.36 | 0.36 | 0.36 |
| Innovative Resins Pvt. Ltd. | Rajasthan | 1.8 | 1.8 | 1.8 |
| Mechemco resins Pvt ltd | Maharashtra | 0.4 | 0.4 | 0.4 |
| Satyen Polymers Pvt. Ltd. | Maharashtra | 0.6 | 0.6 | 0.6 |
| Crystic Resins India Private Limited | Haryana | 0.6 | 0.6 | 0.6 |
| Total |  | 4.84 | 4.84 | 4.84 |

* The Indian market for Epoxy Resins is quite fragmented and none of the manufacturers have capacity more than 100 tonnes per month.
* The Indian total capacity stands at 4.84 thousand Tonnes. Most of the manufacturing plants are in Western and Northern region of India like Maharashtra, Gujarat, Haryana and Rajasthan.
* The market share of Innovative Resins Pvt Ltd. is approximately 35% in the domestic market followed by Orson Chemicals, Satyen Polymers Pvt Ltd, ad Crystic Resins India Private Limited with market share of approximately 14%, 12% and 11%.

**Operating Efficiency**

**India Vinyl Ester Resin Operating Efficiency (Percentage), 2015-2030F**

*Source: TechSci Research*

**India Vinyl Ester Resin Demand, By Volume (000’ Tonnes), 2015-2030F**

*Source: TechSci Research*

**2021-2030F**

**CAGR**

**11.70% By Volume**

**2015-2020**

**CAGR**

**3.10% By Volume**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Approach: Growth Forecast Via Factors (Impact Analysis)** | | | | |
| **Factors** | **Sources** | **Value** | **CAGR** | **Weightage** |
| **GDP Growth Rate (2021-2030 Period)** | ***World Bank, TechSci Estimates*** | ***Forecast*** | 7.50% | 4.00% |
| **GDP Per Capita (%)** | ***World Bank, TechSci Estimates*** | ***Forecast*** | 5.09% | 3.00% |
| **Average Selling Growth (%)** | ***TechSci Research Estimates*** | ***Forecast*** | 3.50% | 3.00% |
| **Growth in Construction\* Sector** | ***TechSci Research Estimates*** | ***Forecast*** | 9.85% | 16.00% |
| **Growth in Renewable Sector** | ***TechSci Research Estimates*** | ***Forecast*** | 9.50% | 34.00% |
| **Growth in Marine Components** | ***Industry Sources & TechSci Research Estimates*** | ***Forecast*** | 16.50% | 38.00% |
| **Market Growth in Historical Period (2015-2020)** | ***Industry Sources & TechSci Research Estimates*** | ***Historical*** | 3.10% | 2.00% |
| **CAGR (2021-2030)** | **11.70%** | | | |

\*Mainly the Pipes & Tanks going in Industrial and manufacturing sector.

TechSci Research has followed this approach to calculate the growth rates by understanding the impact of various factors of the industry. These factors were given weightage according to the relative importance of each factor. Finally, each factor was multiplied with its weightage and their sum was used to calculate market growth.

**Development of 5G technology in India will increase the demand of VER**

* 5G is a fifth-generation cellular network technology which tends to increase the internet speed up to 100 gigabits per second and is expected to be 100 times faster than fourth generation technology (4G) and provides lower latency.
* 5G will be able to support huge number of connected devices without lags and can provide longer battery life which is expected to propel the market of IoT across various manufacturing units. 5G is the foundation for realizing the full potential of IoT.
* For instance, in 2020, Bharti Airtel Ltd launched its internet of things (IoT) platform for enterprises to connect and manage billions of devices and applications. Largest Telecom Player in terms of market share, Reliance Jio announced launch of Jio Phone Next with collaboration of Google.
* VER has application in semiconductor encapsulation that is used manufacturing of smartphones screens. With the rising awareness about the 5G Technology, the demand of smartphone is anticipated to increase the demand of VER Resins.

**India Vinyl Ester Resin Trade Dynamics, By Value (USD million) By Volume- (000’ tonnes)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Imported Country | 2019 | | 2020 | | 2021 | |
|  | Value | Volume | Value | Volume | Value | Volume |
| Spain | 6.36 | 2.44 | 5.34 | 2.09 | 3.57 | 1.27 |
| United Kingdom | 0.80 | 0.02 | 1.74 | 0.59 | 0.13 | 0.05 |
| China | 0.94 | 0.27 | 1.70 | 0.53 | 0.86 | 0.28 |
| Taiwan | 1.42 | 0.63 | 0.99 | 0.49 | 0.21 | 0.08 |
| Japan | 0.00 | 0.00 | 0.76 | 0.29 | 0.37 | 0.14 |
| Others | 3.93 | 4.54 | 2.60 | 2.71 | 7.59 | 5.48 |
| Total | 13.45 | 7.9 | 13.12 | 6.7 | 12.74 | 7.3 |
| Exported Country | 2019 | | 2020 | | 2021 | |
|  | Value | Volume | Value | Volume | Value | Volume |
| Saudi Arabia | 0 | 0.02 | 0 | 0.01 | 0.02 | 0.15 |
| Qatar | 0.06 | 0.16 | 0.03 | 0.08 | 0.02 | 0.06 |
| Bangladesh | 0 | 0.32 | 0 | 0 | 0 | 0.01 |
| United Arab Emirates | 0 | 0.01 | 0.01 | 0.03 | 0 | 0 |
| Bahrain | 0 | 0 | 0 | 0 | 0 | 0.01 |
| Others | 0.04 | 0.09 | 0.03 | 0.28 | 0.01 | 0.03 |
| Total | 0.1 | 0.6 | 0.07 | 0.4 | 0.05 | 0.26 |

**Demand By Type**

**India Vinyl Ester Resin Demand, By Type, By Volume (000’ Tonnes) (%), 2015–2030F**

*Others include Urethane Modified vinyl ester resin, Elastomer Modified vinyl ester resin etc.*

*Source: TechSci Research*

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Demand by Type** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** | **2021E** | **2025F** | **2030F** |
| Bisphenol-A, F,S vinyl ester resin\* | 4.5 | 4.8 | 5.2 | 5.5 | 5.8 | 5.2 | 5.6 | 8.6 | 15.4 |
| Novolac vinyl ester resin | 2.6 | 2.8 | 3 | 3.2 | 3.4 | 3 | 3.3 | 5.1 | 9 |
| Brominated vinyl ester resin | 0.6 | 0.7 | 0.7 | 0.8 | 0.9 | 0.8 | 0.8 | 1.3 | 2.3 |
| Other chemistry | 1 | 1 | 1.1 | 1.1 | 1.2 | 1.1 | 1.4 | 1.8 | 3.3 |
| Total | **8.7** | **9.3** | **10** | **10.6** | **11.3** | **10.1** | **11.1** | **16.8** | **30** |

*Others include Urethane Modified vinyl ester resin, Elastomer Modified vinyl ester resin etc.*

*Source: TechSci Research*

*\*Note: In 2020, the percentage distribution of Bisphenol- A, F and S in India was 92%, 5% and 3%, respectively.*

**India Vinyl Ester Resin Demand Supply Analysis, By Volume, 2015-2030F (Thousand Tonnes)**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** | **2021E** | **2025F** | **2030F** |
| **India** | **Capacity** | 4.8 | 4.8 | 4.8 | 4.8 | 4.8 | 4.8 | 4.8 | 4.8 | 4.8 |
| **Production** | 3.7 | 3.8 | 3.9 | 4.0 | 4.1 | 3.9 | 3.6 | 4.1 | 4.4 |
| **Import** | 5.4 | 6.1 | 6.7 | 7.3 | 7.9 | 6.7 | 0.00 | 0.00 | 0.00 |
| **Export** | 0.4 | 0.5 | 0.6 | 0.6 | 0.6 | 0.4 | 0.00 | 0.00 | 0.00 |
| **Total Demand** | 8.7 | 9.3 | 10.0 | 10.6 | 11.3 | 10.1 | 11.1 | 16.8 | 30.0 |
| **Y-O-Y Growth (%)** | - | 6.90% | 7.53% | 6.0% | 6.60% | -10.62% | 9.90% | 10.86% | 11.21% |
| **Demand Supply Gap** |  |  |  |  |  |  | -7.46 | -12.76 | -25.55 |

*Source: TechSci Research*

**India Vinyl Ester Resin Demand, By Volume, 2020-2030F (000’ Tonnes)**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Demand Scenario** | **2020** | **2021E** | **2022F** | **2023F** | **2024F** | **2025F** | **2026F** | **2027F** | **2028F** | **2029F** | **2030F** |
| Optimistic | 10.11 | 11.33 | 12.8 | 14.59 | 16.59 | 18.81 | 21.64 | 25.16 | 28.93 | 32.96 | 37.48 |
| Realistic | 10.11 | 11.08 | 12.24 | 13.64 | 15.17 | 16.81 | 18.92 | 21.52 | 24.21 | 26.97 | 30 |
| Pessimistic | 10.11 | 10.77 | 11.58 | 12.55 | 13.58 | 14.65 | 16.05 | 17.77 | 19.45 | 21.08 | 22.81 |

*Source: TechSci Research*

**Optimistic**

Driven by V-shaped recovery of the GDP growth rate in the region, consumption levels from key downstream sectors will increase sharply. Government schemes including “Housing for All”, “Smart Cities Mission” to promote the growth of construction sector will push the country’s Vinyl Ester Resin demand growth. Due to its growing inclination towards digitization, demand for Vinyl Ester Resin reinforced PCBs looks to gain traction with Bharat Net and growing push for complete digital literacy. Indian government has envisioned to make the country a manufacturing hub and increasing its GDP share to 25% by 2022. In lieu of that, the Indian government has taken several initiatives and made various policy changes to attract FDIs as well as promote local manufacturing. India is in line with its renewable energy targets and its investments in renewable sources of energy, particularly wind energy is growing tremendously. Advancements in material science present opportunities to explore growth in the renewable energy sector through manufacturing of wind turbines and other equipment manufacturing. Growth prospects in the construction industry, electrical and electronics industry along with automotive industry will led the Vinyl Ester Resin demand growth and will propel capacity expansions in the coming years.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Approach: Growth Forecast Via Factors (Impact Analysis)** | | | | |
| **Factors** | **Sources** | **Value** | **CAGR** | **Weightage** |
| **GDP Growth Rate (2021-2030 Period)** | ***World Bank, TechSci Estimates*** | ***Forecast*** | 10.00% | 8.00% |
| **GDP Per Capita (%)** | ***World Bank, TechSci Estimates*** | ***Forecast*** | 6.22% | 3.00% |
| **Average Selling Growth (%)** | ***TechSci Research Estimates*** | ***Forecast*** | 3.50% | 3.00% |
| **Growth in Construction\* Sector** | ***TechSci Research Estimates*** | ***Forecast*** | 10.05% | 18.00% |
| **Growth in Renewable Sector** | ***TechSci Research Estimates*** | ***Forecast*** | 14.02% | 25.00% |
| **Growth in Marine Components** | ***Industry Sources & TechSci Research Estimates*** | ***Forecast*** | 19.30% | 40.00% |
| **Market Growth in Historical Period (2015-2020)** | ***Industry Sources & TechSci Research Estimates*** | ***Historical*** | 3.10% | 3.00% |
| **CAGR (2021-2030)** | **14.22%** | | | |

\*Mainly the Pipes & Tanks going in Industrial and manufacturing sector.

**Pessimistic**

Vinyl Ester Resin market in India is likely to face numerous challenges in the long-term starting from volatility in the energy market. Being a key importer of crude oil and key raw materials, uncertainties in energy feedstock market outlook adversely impact the country’s petrochemicals market. In lieu of that, the India’s Vinyl Ester Resin market is subject to acute volatility. Series of covid waves due to multiple variants of coronavirus will be a key market determinant in the long term which may affect the GDP growth rate. Covid in the past has resulted in demand deterioration and supply chain disruptions which turned global market upside down and sent GDP growth rates worldwide onto a downward spiral. Growth in economy is vital to some key sectors including construction. The Indian construction industry is driven by infrastructure and housing development, any stagnancy or dip in GDP number is likely to be reflect in its consumption pattern and may hamper epoxy demand growth. Continuous increase in the cost of production (due to rising costs of raw materials, logistics problems and other factors) has also resulted in lopsided market dynamics. In the wake of above factors, manufacturers may take a conservative approach which results in stagnant production and constrained supply fundamentals in the long term.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Approach: Growth Forecast Via Factors (Impact Analysis)** | | | | |
| **Factors** | **Sources** | **Value** | **CAGR** | **Weightage** |
| **GDP Growth Rate (2021-2030 Period)** | ***World Bank, TechSci Estimates*** | ***Forecast*** | 6.82% | 10.00% |
| **GDP Per Capita (%)** | ***World Bank, TechSci Estimates*** | ***Forecast*** | 4.00% | 5.00% |
| **Average Selling Growth (%)** | ***TechSci Research Estimates*** | ***Forecast*** | 3.42% | 5.00% |
| **Growth in Construction\* Sector** | ***TechSci Research Estimates*** | ***Forecast*** | 8.10% | 15.00% |
| **Growth in Renewable Sector** | ***TechSci Research Estimates*** | ***Forecast*** | 9.50% | 30.00% |
| **Growth in Marine Components** | ***Industry Sources & TechSci Research Estimates*** | ***Forecast*** | 12.00% | 28.00% |
| **Market Growth in Historical Period (2015-2020)** | ***Industry Sources & TechSci Research Estimates*** | ***Historical*** | 3.10% | 7.00% |
| **CAGR (2021-2030)** | **8.70%** | | | |

\*Mainly the Pipes & Tanks going in Industrial and manufacturing sector.

**Demand By Application**

**India Vinyl Ester Resin Demand, By Application, By Volume (000’ Tonnes) (%), 2015–2030F**

*Others include Défense, Aerospace, Electrical and electronics etc.*

*Source: TechSci Research*

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Demand by Application (000’ Tonnes)** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** | **2021E** | **2025F** | **2030F** |
| Pipes & Tanks | 5.3 | 5.6 | 6.1 | 6.4 | 6.9 | 6.2 | 6.8 | 10.3 | 18.6 |
| Marine Components | 1.8 | 1.9 | 2 | 2.2 | 2.3 | 2.1 | 2.3 | 3.5 | 6.2 |
| Renewables | 0.6 | 0.7 | 0.7 | 0.8 | 0.8 | 0.7 | 0.8 | 1.2 | 2.1 |
| Others | 1 | 1.1 | 1.2 | 1.2 | 1.3 | 1.1 | 1.2 | 1.8 | 3.1 |
| **Total** | **8.7** | **9.3** | **10** | **10.6** | **11.3** | **10.1** | **11.1** | **16.8**  *Others include Défense, Aerospace, Electrical and electronics etc.*  *Source: TechSci Research* | **30.0** |

**India Market Insights**

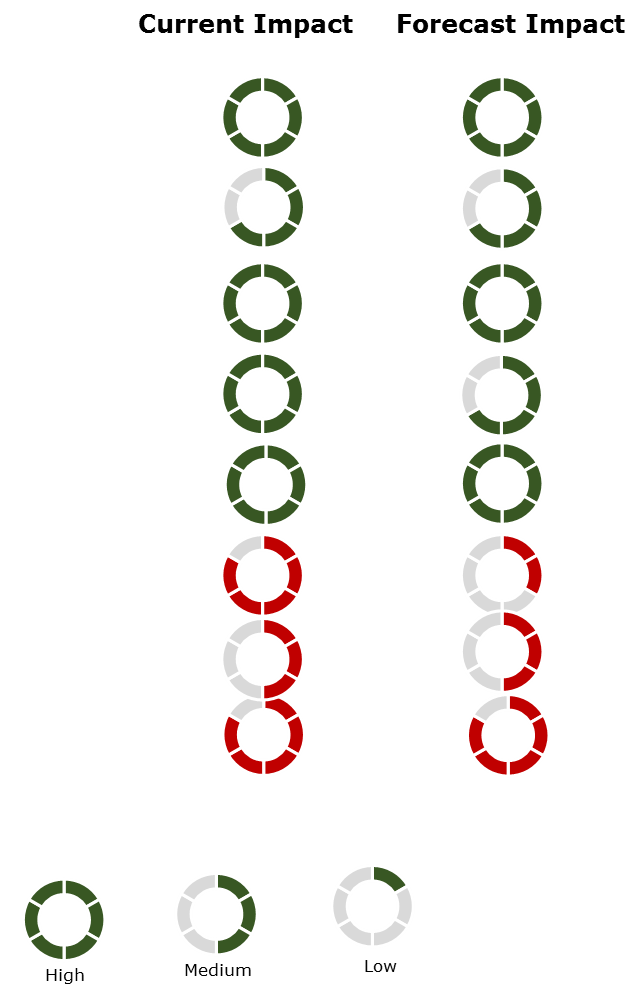
India’s VER capacity stood around 4.8 KT in 2020 and the resin demand is anticipated to grow at a CAGR of 11.70% (by volume) between 2021-2030. Vinyl ester resins finds varied applications due to their high chemical and electrical resistivity that serve several critical industries. Because of their varied applications, Epoxy resins find high utility in end user products which relates the demand growth of Epoxy Resins to India’s overall GDP.

cTrade dynamics of the country show that Saudi Arabia, Qatar and Bangladesh are the key importers of Indian VER while Spain, United Kingdom and China are the top three exporters of VER to India.

By type, Bisphenol A, F and S-based vinyl ester resin dominate the Indian VER industry with around 50.71% demand share as of 2020. Due to their desirable characteristics, BPA-based VERs have portrayed strong growth projections in the forecast years as well. Novolac VER resin holds nearly 30% demand share in the Indian VER market

Based on application, Pipes and Tanks dominate the Indian VER demand, holding more than 60% share of the country’s total demand. Demand for Marine components is around 20% of the total while others hold more than 10% share of the resin demand.

**3.8. MARKET DYNAMICS**

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**Growing usage as Lining System in Industrial Applications**

**Robust Growth of Construction Sector**

**Aging Infrastructure**

**Increase in demand of LCD and touch panels due to adaptation of 5G mobile technology**

**Fragmented Downstream Market**

**Government support in India to increase per capita consumption of FRP composites**

**Fluctuation In Raw Material Prices**

**Supply Chain Disruption**

*\*Green color denotes market drivers \*Red color denotes market challenges*

**Market Drivers**

***Government support in India to increase per capita consumption of FRP composites***

Driven by strong demand from various end use industries such as wind energy, transportation, electrical and electronics, defence, aerospace, pipes and tanks, construction and marine, the composite industry, also known as fibre-reinforced plastics (FRP) industry, will also be supporting government’s ‘Make in India’ initiative giving a big push to future market of vinyl ester resin. The per capita consumption of composites in China and the United States has been 2.8 kg and 11.4 kg, respectively in 2021. The per capita consumption in India stood at 0.36 kg in 2021, which is the lowest.

***Growing usage as Lining System in Industrial Applications***

Vinyl ester resin lining systems are used in several industrial applications like water treatment, chemical processing, and air pollution control and mineral processing as they provide unparallel corrosion resistance to fiberglass reinforced plastic tanks, ducting, stacks & chimneys, scrubbers, pipes and other components. Therefore, vinyl ester resin liners fit best for the most challenging industrial environments due to their properties like high heat resistance, exceptional durability, and minimal maintenance requirements.

***Robust Growth of Construction Sector***

With rising urban population and public and private sector investments in construction projects, the overall construction market is witnessing rapid growth. The demand for vinyl ester resins in building & construction industry has been rising over the last few years owing to their varied Types including Bisphenol, Novolac and Brominated. Robust growth in construction sector in Japan coupled with the implementation of favourable government policies to support infrastructure development are the primary factors expected to influence the demand.

***Aging Infrastructure***

The aging infrastructure is driving opportunities for building materials including VER based FRP tanks. Most of the infrastructure such as roads, water supply and sewerage systems constructed in developed nations are 30-40 years old. The government and local civic bodies incur huge maintenance cost hence there is an urgent need for repair of these systems.

**Europe Percentage of Infrastructure that is minimum 50 years old, 2018, 2023 & 2033**

|  |  |  |  |
| --- | --- | --- | --- |
|  | 2018 | 2023 | 2033 |
| Highway Bridges | Approx. 25% | Approx. 39% | Approx. 63% |
| Tunnels | Approx. 20% | Approx. 27% | Approx. 42% |
| River Management Facilities | Approx. 32% | Approx. 42% | Approx. 62% |
| Sewage Pipes | Approx. 4% | Approx. 8% | Approx. 21% |

*Source: Eurostat*

**Market Challenges**

***Fragmented market of composites industry in China and India***

The fragmented composite industry in India and China consists of around 15000 stakeholders in the value chain including small, mid-sized and large players. Also, the lack of awareness among end- user industries is the major challenge for the growth of vinyl ester which also impacts the margin of the industry. Lack of regulatory framework, absence of a recycling policy and standardization of end-use products are some of the major challenges for the composites industry. Global composites market is highly fragmented with more than 1000 mid and small regional players operating in the market.

***High Volatility in Raw Material Prices***

Styrene, epoxy resin, methacrylic acid, etc., are few of the raw materials majorly used in the production of construction sealants and bonding such as butyl rubber, acrylic urethane, silicone rubber sealant, etc. Over the years, raw materials used in sealants industry have observed price fluctuations globally. Diligently working on product selling prices to react to changes in raw material cost and simultaneously maintaining market share is a key challenge for construction sealants producers

**India Styrene Monomer, Methacrylic Acid, Epoxy Resin and Bisphenol A Prices, 2017-2021E (USD per Ton)**

*Source: TechSci Research*

**3.9. MARKET TRENDS & DEVELOPMENTS**

***Capacity Expansion by Existing Players in APAC Region***

With growing demand for Vinyl Ester Resin in various sector such as wind energy, transportation, electrical and electronics, defence, aerospace, pipes and tanks, construction and marine, companies have started investing in expanding manufacturing facilities. Moreover, companies are increasingly focusing on developing nations like China and India, due to availability of cheap labour in these countries. For instance, Showa Denko Group completes expansion of lines to produce vinyl ester in Shanghai due to increasing demand of the product in electronic parts such as Liquid Crystal Displays (LCDs) and touch panels on account of the progress in telecommunication technologies.

***Emerging applications***

The emerging application of vinyl ester resin is in electronics and telecommunication due to its use in the process to produce electronic parts including LCDs and touch panels, which has been rapidly increasing in APAC region mainly in China. Moreover, its application in pipes and tanks, marine industry, defence, transportation, etc. has been rapidly increasing due to its excellent corrosion resistance and chemical resistance properties. Vinyl Ester resins’ usage in the making of pipes and tanks also adds to their increasing demand. Growing utilization of Vinyl Ester Resins in electronics and telecommunications is likely to increase its foothold in the market over coming years.

**Electrical & Electronics Industry Market Share in Vinyl Ester Resin Applications, 2020, 2025F and 2030F**

The future wave in the telecom industry is the 5G network, which covers less distance than the existing 4G network. In India, the Ministry of Telecommunications and The Telecom Regulatory Authority of India (TRAI) plans to implement 5G in the coming years. With this implementation, usage of VER for the telecom industry is expected to register strong growth in the coming years.

10x Lower

Latency

3x Spectral Efficiency

5x Energy Efficient

10x Lower IoT Power

***Mergers and Acquisitions***

Merger & acquisition activities are becoming prevalent in the vinyl ester resin market globally. In 2019, INEOS Composites acquired Ashland Composites. Additionally, Polynt and Reichhold also had a merger in the same year to expand and increase their market share. Showa Denko, a prominent player in the vinyl ester resin market, is continuously expanding its capacity to cater to the increasing demand in China.

|  |  |  |  |
| --- | --- | --- | --- |
| **Mergers & Acquisitions in Vinyl Ester Resin Industry** | | | |
| **S.No.** | **Target Company** | **Acquirer / Merged Entity** | **Year** |
| 1 | Mar-Bal Inc | Chagrin Falls, Ohio | 2020 |
| 2 | Ashland Global Holdings Inc. | INEOS Enterprise | 2019 |
| 3 | Aliancys & AOC Resin | CVC Capital Partners | 2018 |
| 4 | Polynt | Reichhold Group | 2017 |
| 5 | Kemrock Industries Ltd | Reliance Industries Ltd | 2018 |

*Source: TechSci Research*

**3.10. Technology Evaluation:**

Vinyl Ester Resins are downstream products of Epoxy Resin. Most manufacturing companies have their in-house technologies and R&D facilities to make formulations. Key reactions are carried out with the help of a batch reactor and blender which can be outsourced. Conventionally, manufacturing process involves charging batch reactor with a feedstock and then blending it with an organic solvent such as styrene monomer. There is no technology licensor for the product. Indian manufacturing companies such as Innovative Resins, Satyen Polymers, Mechemco Resins among others have In-house batch reactor set up. However, they depend on domestic or international market for feedstocks Epoxy resin, Bisphenol-A, and other additives.

**3.11. Pricing Analysis**

Discussions on Vinyl Ester Resin remained firm since the beginning of 2021 following the pickup in the market activities as the economy significantly rebounded from COVID-19 repercussions. However, the increment has been marginal yet consistent due to constraint fluctuations in base Novolac costs. There has been little to no adverse impact of the second wave of Covid in India, as demand for the material remained consistent from packaging sector amidst favourable consumer sentiments. Thus, after showcasing a marginal dullness in May 2021, prices again revived in June 2021, following the resumption in market activities across the nation. Besides, soaring freight cost along several trade routes since the beginning of 2021 has also contributed to raise in values at times of prevalent demand pattern.

**Global Vinyl Ester Resin Yearly Prices, 2015-2030 (USD/Tonne)**

Vinyl Ester Resin market which faced dullness earlier under COVID-19 repercussion has witnessed a significant rebound across the global market since January 2021. Global freight cost hike has also impacted the overall market fundamentals for VER across international market. Some major players like AOC frequently revised their offers for Epoxy based VER to tackle rising freight charges, and feedstock cost since January. Meanwhile, countries like UK were heard struggling to procure enough raw materials to satisfy the domestic consumption, which impacted the price trend across Europe. However, during May-July 2021, while India was battling with second wave of pandemic, other countries witnessed mixed sentiments that varied with rate of economic recovery and ongoing pandemic related restrictions. Some factors like freight cost and raw material scarcity remained common behind any significant increase in prices of VER across the globe.

As per the analysis, it was observed that demand for both Epoxy and Novolac based VER runs parallelly across the global market. However, fluctuations in prices of VER primarily emerge after considerable revisions in prices of raw materials. Therefore, due to differences in raw materials, hike in prices may differ, but both Novolac and Epoxy based VER shares the similar market dynamics. Epoxy based VER usually varies with Bisphenol A (BPA) and Epichlorohydrin (ECH) price trend, while Novolac based Epoxy fluctuates with phenol and formaldehyde price dynamics.

**Basis for Price Forecasting**

The price of vinyl ester resin has been forecasted by using annual average delta method, wherein:

·                 the price during last ten years is considered.

·                 these prices, if available monthly or quarterly are

          averaged on annual basis.

  ·                 the annual delta for last ten years is worked out.

·                 the average annual delta is computed.

The delta takes into consideration the anomalies of price fluctuation due to many factors such as:

-                  Exchange rate

-                  Conversion rate

-                  Demand / availability scenario

-                  Feedstock price changes

-                  Geo-political scenario

-                  Global economy, etc.

-                  Inflation

-                  Taxation.

The annual average delta is used to forecast the price taking current price as a base. The above factors are in- built in annual average delta.

Presently, crude oil price fluctuations are showing considerable volatility due to several socio-political factors worldwide. Various influencing factors for price forecast include raw-materials / feedstock prices and demand – supply balances in the region which built the relationship of product to substitute products having comparable properties and common end-uses as well as their prices.

Feedstock prices directly affect the price of product. Increased feedstock prices, if passed on to end-users, increase the inflation and if not, they squeeze the margins of producers leading to making the industry unattractive for further investments. This leads to supply crunch and shortage of product in the market. The shortage leads to further increase in prices of product.

The uncertainty over development of economic environment renders the forecasting exercise futile. Therefore, the forecasting exercise is always done with set of assumptions. The assumptions in this exercise are as under:

* The crude oil prices will remain within average limits during the next ten years.
* The technologies in exploration and production activities will continuously evolve leading to lower cost of production, better margins and extra investment in E&P activities.
* No technological innovations of substantial magnitude will take place which may lead to sea-change in technologies / processes used today.
* Current Exchange Rate will change during the forecast period.

**3.12. Value Chain Analysis for Captive Vinyl Ester Resin Manufacturer**

**Value Flow Analysis for Captive Vinyl Ester Resin Manufacturer**

Epoxy Resin (Inhouse production) (USD 2.39 /Kg**)**

**Vinyl Ester Resin Value Chain**

**Manufacturer**

**Percentage Margin 32.7%**

**Including Transportation charges**

Current Selling Price (USD 4.0 / Kg) Direct Sales

Raw Material Cost (USD 1.92/Kg)

**In-Direct Sales**

Bisphenol-A(USD 1.4 /Kg)

Overhead & Packaging cost (USD 0.57 / Kg)

Methacrylic Acid (USD 2.72 /Kg)

Styrene Monomer (USD 1.45 /Kg)

Total Cost Incurred (USD 2.49 / Kg)

Current Selling Price (USD 3.7/ Kg) In-Direct Sales

**Direct Sales**

**Percentage Margin 37.7%**

**Company Website/Direct Export/Direct Sales**

**Distributor/Retailer**

**End Use**

**Value Flow Analysis for Non-Captive Vinyl Ester Resin Manufacturer**

Epoxy Resin (USD 3.03 /Kg**)**

**Manufacturer**

**Percentage Margin 27%**

**Including Transportation charges**

**In-Direct Sales**

**Direct Sales**

Bisphenol-A (USD 1.4 /Kg)

Raw Material Cost (USD 2.12 /Kg**)**

Overhead & packaging Cost (USD 0.57 /Kg)

Methacrylic Acid (USD 2.72 /Kg)

Styrene Monomer (USD 1.45 /Kg)

Current Selling Price (USD 4.0/ Kg) Direct Sales

Total Cost Incurred (USD 2.69 /Kg)

Current Selling Price (USD 3.7 / Kg) In-Direct Sales

**Percentage Margin 32.75 %**

**Vinyl Ester Resin Value Chain**

**Company Website/Direct Export/Direct Sales**

**Distributor/Retailer**

**End Use**

**3.13. Cost of Production**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **COST OF PRODUCTION** | | | | |
|  |
|  |  | **Norm of Consumption (Tonne)** | **Unit Rate** | **Amount** |  |
|  |  | **USD / Tonne** | **USD** |  |
| A | **VARIABLE COST** |  |  |  |  |
| 1 | RAW MATERIALS |  |  |  |  |
| I | Epoxy Resin | 0.3 | 3030 | 909 |  |
| II | BPA | 0.14 | 1400 | 196 |  |
| III | Methacrylic Acid | 0.11 | 2720 | 299 |  |
| IV | Styrene Monomer | 0.45 | 1450 | 653 |  |
|  | **Sub-Total (1)** |  | 8600 | 2057 |  |
| 2 | Packing Materials |  |  | 147 |  |
| 3 | Catalyst & Chemicals |  |  | 65 |  |
| 4 | Utilities |  |  | 55 |  |
|  | **TOTAL VARIABLE COST** | **2324** |  |  |  |
| **B** | **FIXED COST** |  |  |  |  |
| 1 | Repair & Maintenance |  |  | 250 |  |
| 2 | Salaries & Wages |  |  |  |  |
| 3 | Research & Development |  |  |  |  |
| 4 | Transportation & Clearance |  |  |  |  |
| 5 | Corporate Overheads |  |  |  |  |
|  | **TOTAL FIXED COST** |  |  | **250** |  |
| **C** | **VARIABLE + FIXED COST** |  |  | **2574** |  |
| **D** | **INTEREST ON WORKING CAPITAL** |  |  | **20** |  |
| **E** | **CASH MANUFACTURING COST** |  |  | **2594** |  |
| **F** | **DEPRECIATION** |  |  | **1.9** |  |
| **G** | **PRODUCTION COST** | **2596** |  |  |  |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **COST OF PRODUCTION (Novolac Epoxy Vinyl Ester)** | | | | |
|  |
|  |  | **Norm of Consumption (Tonne)** | **Unit Rate** | **Amount** |  |
|  |  | **USD / Tonne** | **USD** |  |
| A | **VARIABLE COST** |  |  |  |  |
| 1 | RAW MATERIALS |  |  |  |  |
| I | Epoxy Resin (Novalac Based) | 0.4 | 6060 | 2424 |  |
| II | Methacrylic Acid | 0.12 | 2720 | 326.4 |  |
| III | Maleic Anhydride | 0.03 | 1770 | 53.1 |  |
| IV | Styrene Monomer | 0.44 | 1450 | 638 |  |
|  | **Sub-Total (1)** |  | 12000 | 3441.5 |  |
| 2 | Packing Materials |  |  | 147 |  |
| 3 | Catalyst & Chemicals |  |  | 65 |  |
| 4 | Utilities |  |  | 55 |  |
|  | **TOTAL VARIABLE COST** | **3708.5** |  |  |  |
| **B** | **FIXED COST** |  |  |  |  |
| 1 | Repair & Maintenance |  |  | 250 |  |
| 2 | Salaries & Wages |  |  |  |  |
| 3 | Research & Development |  |  |  |  |
| 4 | Transportation & Clearance |  |  |  |  |
| 5 | Corporate Overheads |  |  |  |  |
|  | **TOTAL FIXED COST** |  |  | **250** |  |
| **C** | **VARIABLE + FIXED COST** |  |  | **3958.5** |  |
| **D** | **INTEREST ON WORKING CAPITAL** |  |  | **20** |  |
| **E** | **CASH MANUFACTURING COST** |  |  | **3978.5** |  |
| **F** | **DEPRECIATION** |  |  | **1.9** |  |
| **G** | **PRODUCTION COST** | **3980.4** |  |  |  |

**3.14. Customer Analysis**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Destination Country** | **Product Description** | **Customer / Distributor Name** | **Supplier Name** | **Annual Off-take Quantity (Tonnes)** | **Price Range (USD/kg)** |
| India | Bisphenol-a Type Epoxy Vinyl Ester Resin | Reichhold India Private Limited | Reichhold Polymers Tianjin, China | 2600 | 3.4-4.23 |
| Saudi Arabia | Bisphenol-a Type Epoxy Vinyl Ester Resin | Saudi Arabian AMIANTIT Company | Sino Polymer, China | 1440 | 5.25-6.53 |
| India | Bisphenol-a Type Epoxy Vinyl Ester Resin | Orson Chemicals | Swancor Ind M Sdn Bhd, Malaysia/Taiwan | 1050 | 2.3-2.87 |
| Egypt | Bisphenol-a Type Epoxy Vinyl Ester Resin | Future Pipe Industries | Eternal Materials Co Ltd, Taiwan | 600 | 2.46-3.06 |
| India | Novolac Vinyl Ester Resin | Chemical Process Equipments Pvt Ltd | Ineos Composites, Spain | 470 | 5.17-6.43 |
| India | Bisphenol-a Type Epoxy Vinyl Ester Resin | Sunrise Industries India Ltd | Jinling AOC Resins Co Ltd, China/Thailand | 370 | 3.17-3.94 |
| India | Bisphenol-a Type Epoxy Vinyl Ester Resin | Carborundum Universal Limited | Swancor Ind M Sdn Bhd, Malaysia/Taiwan/China | 290 | 2.01-2.5 |
| India | Bisphenol-a Type Epoxy Vinyl Ester Resin | Nagase India Private Limited | Showa Highpolymer Singapore Pte Ltd, Japan | 240 | 2.71-3.37 |
| India | Bisphenol-a Type Epoxy Vinyl Ester Resin | Epp Composites Pvt Ltd | Eternal Materials Co Ltd, Taiwan | 48 | 2.86-3.56 |
| India | Bisphenol-a Type Epoxy Vinyl Ester Resin | Vibrant Specialties | Synthomer Trading Limited, France | 40 | 1.99-2.48 |
| India | Bisphenol-a Type Epoxy Vinyl Ester Resin | Rex Resins | Eternal Materials Co Ltd, Taiwan | 35 | 1.89-2.35 |
| India | Bisphenol-a Type Epoxy Vinyl Ester Resin | Dakle Industrial Plastics | M S Swancor Highpolymer Co Ltd, Taiwan | 32 | 2.08-2.59 |
| India | Bisphenol-a Type Epoxy Vinyl Ester Resin | Apex Printing Sleeves India Private Limited | M S AOC LLC, United States of America, Poland | 30 | 6.38-7.94 |
| India | Bisphenol-a Type Epoxy Vinyl Ester Resin | BASF India Limited | BASF Construction Chemicals UAE LLC, United Arab Emirates | 25 | 10.13-12.61 |
| India | Bisphenol-a Type Epoxy Vinyl Ester Resin | JRD Polymer Pvt Ltd | Aliancys Ag, France | 16 | 3.48-4.33 |
| Pakistan | Bisphenol-a Type Epoxy Vinyl Ester Resin | Bin Tariq (Pvt) Limited | Changzhou Pro-tech Trade Co.,Ltd,, China | 14 | 2.13-2.65 |
| Pakistan | Bisphenol-a Type Epoxy Vinyl Ester Resin | Fiber Craft Inds. | Saudi Industrial Resins Limited, Saudi Arabia | 12 | 2.88-3.58 |
| India | Bisphenol-a Type Epoxy Vinyl Ester Resin | Devi Polymers Private Ltd | Eternal Materials Co Ltd, Taiwan | 10 | 2.1-2.61 |
| Sri Lanka | Bisphenol-a Type Epoxy Vinyl Ester Resin | B A F F Polymech Pvt Ltd | Scott Bader Middle East Ltd, United Arab Emirates | 8 | 4.05-5.04 |
| India | Bisphenol-a Type Epoxy Vinyl Ester Resin | Hindustan Zinc Limited | China Nonferrous Metal Industrys Foreign Engineeri, China | 5 | 6.4-7.96 |
| India | Novolac Vinyl Ester Resin | Mahindra Cie Automotive Limited | M S Swancor Highpolymer Co Ltd, Taiwan | 3 | 2.5-3.11 |
| India | Novolac Vinyl Ester Resin | Mahindra Cie Automotive Limited | M S Swancor Highpolymer Co Ltd, Taiwan | 3 | 2.5-3.11 |
| Sri Lanka | Bisphenol-a Type Epoxy Vinyl Ester Resin | Edgeng Pvt Ltd | Wee Tee Tong Chemicals Pte Ltd, Singapore | 3 | 2.32-2.89 |
| India | Bisphenol-a Type Epoxy Vinyl Ester Resin | Emerald Performance Chemical Private Limited | Eternal Materials Co Ltd, Taiwan | 2 | 1.84-2.28 |
| India | Bisphenol-a Type Epoxy Vinyl Ester Resin | Kalinga Inceptum Private Limited | Eternal Materials Co Ltd, Taiwan | 2 | 2.65-3.29 |

*Source: TechSci Research*

**3.15. Global Foreign Trade Analysis**

**Global Vinyl Ester Resin Trade Dynamics – Import (000’ Tonnes), 2015-2020**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Country** | **2015** | | **2016** | | **2017** | | **2018** | | **2019** | | **2020** | |
| **Import** | **Value** | **Volume** | **Value** | **Volume** | **Value** | **Volume** | **Value** | **Volume** | **Value** | **Volume** | **Value** | **Volume** |
| United States | 25.63 | 12.83 | 32.61 | 15.03 | 30.15 | 15.03 | 42.94 | 17.95 | 28.04 | 14.81 | 26.91 | 16.82 |
| China | 5.12 | 2.73 | 35.81 | 17.05 | 50.05 | 24.06 | 38.05 | 19.92 | 35.91 | 19.92 | 20.05 | 11.71 |
| Brazil | 6.42 | 3.15 | 13.55 | 6.1 | 12.88 | 6.7 | 15.03 | 7.25 | 14.91 | 7.30 | 12.91 | 6.95 |
| India | 5.16 | 2.44 | 8.12 | 4.05 | 11.21 | 5.91 | 6.22 | 3.05 | 8.94 | 4.15 | 9.15 | 6.70 |
| Mexico | 3.05 | 1.52 | 6.42 | 3.21 | 8.25 | 4.20 | 6.21 | 3.05 | 7.25 | 3.77 | 9.21 | 5.62 |
| Turkey | 2.15 | 1.05 | 4.15 | 2.82 | 6.43 | 3.25 | 5.62 | 2.85 | 6.21 | 3.05 | 5.10 | 3.92 |
| South Africa | 5.12 | 2.50 | 5.12 | 2.73 | 4.21 | 2.12 | 5.21 | 2.62 | 5.53 | 2.91 | 4.73 | 2.84 |
| Russia | 2.44 | 1.73 | 4.41 | 2.73 | 3.21 | 1.56 | 4.15 | 1.82 | 5.25 | 2.81 | 5.12 | 2.82 |
| Indonesia | 5.81 | 3.05 | 3.12 | 1.55 | 3.04 | 1.22 | 2.63 | 1.73 | 5.05 | 2.54 | 3.57 | 2.05 |
| Vietnam | 10.25 | 5.4 | 2.84 | 1.50 | 1.26 | 0.63 | 3.05 | 1.44 | 1.83 | 1.00 | 2.44 | 1.44 |
| Others | 109.66 | 89.57 | 109.68 | 65.33 | 70.75 | 52.99 | 91.44 | 52.99 | 125.89 | 59.12 | 151.36 | 45.10 |
| **Total** | **180.91** | **125.99** | **225.83** | **122.12** | **201.44** | **117.69** | **220.55** | **114.67** | **244.81** | **121.38** | **250.55** | **105.97** |

*Others Argentina, Iran, Qatar etc.*

*Source: TechSci Research*

**Global Vinyl Ester Resin Trade Dynamics – Export (000’ Tonnes), 2015-2020**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Country** | **2015** | | **2016** | | **2017** | | **2018** | | **2019** | | **2020** | |
| **Export** | **Value** | **Volume** | **Value** | **Volume** | **Value** | **Volume** | **Value** | **Volume** | **Value** | **Volume** | **Value** | **Volume** |
| South Korea | 22.73 | 11.04 | 15.09 | 8.41 | 15.38 | 9.18 | 15.59 | 9.20 | 11.04 | 6.33 | 11.82 | 6.53 |
| Germany | 26.13 | 12.02 | 28.10 | 12.16 | 23.63 | 15.66 | 35.37 | 13.65 | 41.97 | 16.11 | 37.58 | 15.48 |
| Spain | 19.32 | 9.20 | 16.55 | 9.30 | 19.75 | 12.88 | 24.57 | 10.53 | 25.69 | 14.45 | 25.65 | 14.70 |
| China | 17.74 | 7.68 | 22.24 | 7.77 | 23.84 | 10.54 | 21.06 | 7.61 | 28.95 | 12.27 | 25.91 | 10.14 |
| Japan | 13.54 | 6.39 | 12.12 | 6.46 | 11.94 | 8.25 | 13.61 | 6.35 | 13.68 | 7.95 | 13.19 | 7.12 |
| Netherlands | 6.12 | 2.36 | 5.16 | 2.39 | 5.68 | 3.28 | 6.70 | 2.73 | 6.85 | 3.50 | 6.58 | 3.64 |
| USA | 4.42 | 2.16 | 3.52 | 2.18 | 4.14 | 2.84 | 5.84 | 2.62 | 5.61 | 3.37 | 5.00 | 3.25 |
| Poland | 6.73 | 3.00 | 5.20 | 3.03 | 5.92 | 4.06 | 6.57 | 2.77 | 5.43 | 2.87 | 4.92 | 2.71 |
| Saudi Arabia | 5.39 | 2.37 | 6.56 | 2.40 | 9.23 | 3.30 | 8.54 | 3.03 | 9.63 | 3.34 | 6.36 | 2.53 |
| Taiwan | 3.87 | 1.95 | 4.72 | 1.97 | 5.59 | 2.65 | 6.15 | 2.37 | 6.74 | 2.65 | 6.70 | 2.38 |
| Others | 117.15 | 67.82 | 121.74 | 66.06 | 111.80 | 45.05 | 90.85 | 53.81 | 71.07 | 48.54 | 69.80 | 37.49 |
| **Total** | **243.15** | **125.99** | **241.01** | **122.12** | **236.89** | **117.69** | **234.86** | **114.67** | **226.64** | **121.38** | **213.51** | **105.97** |

*Others Finland, Turkey, Russia etc*

*Source: TechSci Research*

**3.16. Suggested Capacities**

***Global Scenario:*** The current global capacity of Vinyl Ester Resin is 985 thousand tonnes. Top five producers account for 54 percent of the total capacity. Regional analysis indicates surplus in Northeast Asia, and deficit in Indian Sub-continent, Europe, South America, Middle East, and South America, resulting in heavy trade within the region as well as international trade. Overall Europe, Middle East & Africa and South America will remain a deficit area throughout the study period.

***Indian Scenario:*** Present capacity in the country is 4.84 thousand tonnes and production are totally project based. These companies produce all the major grades conforming with global standards. It is expected that, based on individual end-use sector growth, consumption of vinyl ester resin will register an overall growth of about 11.70 percent per annum average growth over the next ten years’ period.

India is expected to remain a deficit area and likely to increase from present level of 7.16 thousand tonnes per annum to 24.74 thousand tonnes per annum by 2030.

Considering demand – supply situation and export market, enough scope exists in the country for a 30 thousand tonnes per annum vinyl ester resin unit by 2023. Moreover, there is latent demand of the product due to anticipated growth in telecom, chemicals & petrochemicals, and renewable sector.

**Recommendations**

* RIL may consider setting-up a 30 thousand tonnes vinyl ester resin unit as enough scope exists from demand – supply point of view. However, before taking up this decision, should also consider the project from economic viability point of view.
* Considering capacity utilization of 60 percent in first year and 90 percent in second year onwards, entire quantity is likely to be absorbed within the country itself by 2030.
* Although as per demand – supply position, substantial gap in international markets is expected, exploring export is also advisable from realization angle.
* Reliance Industries Ltd should also have 100 percent captive epoxy resin unit for better margin and assured supply of critical raw materials.

|  |  |  |  |
| --- | --- | --- | --- |
| **Name of the Product (KTPA)** | **2023** | **2027** | **Total** |
| **Unsaturated Polyester Resin** | 25 | 25 | 50 |
| **Vinyl Ester Resin** | 15 | 15 | 30 |

**Project Description**

**4.1. Setup Related Details**

**4.1.1. Target End-Use Applications**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| S. No | Grade | Target Applications | Specifications | | |
| Viscosity 25° C (cps) | Gel Time (min) | Monomer Content (%) |
| 1 | Bisphenol-A Epoxy Vinyl Ester Resin | Provide Resistance to acid, alkalis, solvents, excellent toughness, and fatigue resistance | 180-800 | 20-32 | 33-45 |
| 2 | Low styrene Monomer Bisphenol-A Vinyl Ester Resin | Chemical reaction vessels | NA | NA | NA |
| 3 | Novolac Based Epoxy Vinyl Ester Resin | Excellent thermal, and chemical resistance, resistance to solvents, acids | 300-400 | 20-25 | 36-40 |
| 4 | Brominated Epoxy Vinyl Ester Resin | High degree of fire retardance, resistance to chemical, tougher and fatigue resistant | 200-500 | 20-35 | 34-39 |
| 5 | Brominated Novolac Epoxy Vinyl Ester Resin | Moderate degree of retardance, application in hot, wet flue gas environment | 300-450 | 20-35 | 36-40 |
| 6 | Elastomer-modified Bisphenol-A Epoxy Vinyl Ester Resin | High impact and fatigue resistance, chemically resistant FRP linings, composites, adhesives, electrical castings, electrical laminates, and fibres | 40-8000 | NA | NA |
| 7 | Urethane Modified Vinyl Ester Resin | Heat, Corrosion and Chemical resistant, application in marine, pultrusion, carbon fibre | NA | NA | NA |
| 8 | Amine Accelerated Vinyl Ester Resins | Composites | 300-500 | 10-15 | 34-41 |
| 9 | Bisphenol A Vinyl ester/ DCPD blend | Hydrolysis resistance, Marine | NA | 27-33 | 60-64 |

**\******Gel Time refers to the time taken by the resin (VER) to transform from liquid to highly viscous gel state in which the resin is no longer workable.***

*Source: TechSci Research*

**Application in Carbon Fibre & composites (Composites):** Since carbon fibre reinforced composites offer great mechanical properties with a low density, they have been of interest to many fields, such as military equipment, transportation, and sport and recreation goods. Carbon fibre composites are especially used in the aerospace and aeronautics industries when the required mechanical properties have to be outstanding. However, with the price of carbon fibres decreasing their uses increase, spreading into a wider range of applications. Specific demands related to mechanical properties, resistance to chemicals and environment, process and cost of manufacture have led to an investigation of the use of different types of matrices. Vinyl ester resins are being widely used for many advanced composites due to their many advantages such as excellent adhesion to wide ariety of fibres, corrosion resistance, good performance at elevated temperatures and superior mechanical and Electrical properties.

**4.1.2. Plant Process Description**

*Source: TechSci Research*

**Manufacturing Process**

# Vinyl Ester Resin (VER) has been manufactured in a batch reactor, traditionally. Initially, the reactor needs to be charged with a mixture of Epoxy resin, Bisphenol-A and should be heated for 4-5 hours at temperature of 160-170°C. Then, decrease the reactor temperature to 100-120°C and add Methacrylic acid to advance the esterification process. Esterification takes place along the epoxy chain between carboxyl and epoxy group and likewise between carboxyl and hydroxyl group. As the temperature declines to 100° C, additives like Maleic Anhydride and Tri-Ethyl Amine needs to be added as a base catalyst and the mixture is heated for another 4-6 hours.

# After that, Epoxy Resin needs to be withdrawn from the batch reactor and fed to the blender containing Styrene Monomer which is a volatile organic solvent. During polymerization, styrene reacts with vinyl esters to form cross linking at unsaturation points. This cross linking make the resin polymerizable and improves resin processability. In addition to this, Styrene Monomer also acts as a diluent to reduce viscosity and improve curing degree leading to excellent mechanical and thermal properties of composite epoxy solution. Further, Blender temperature should be maintained around 70° C. Finally, Water is circulated around blender jacket to gradually cool and reduce the heat to room temperature. Generally, it takes 12-14 hours to process Vinyl Ester Resin. It’s a very critical and temperature sensitive reaction and should be undertaken with utmost caution as a small error can gel the batch immediately.

# As all the raw materials used will be consumed in the process itself, hence there will not be any generation of by-product, Effluent, Gaseous waste, solid waste.

Finally, the finished product is withdrawn from blender and packed in drums.

A picture containing chart

Description automatically generated**Reaction Involved**

Polygon

Description automatically generated with medium confidence

Diagram

Description automatically generated with low confidence

Chart, box and whisker chart

Description automatically generated

A picture containing radar chart

Description automatically generated

Diagram

Description automatically generated with medium confidenceDiagram

Description automatically generated

**Curing Of Vinyl Ester Resin**

Vinyl Ester Resins must undergo curing process where low molecular weight liquid resins convert into high molecular weight liquid resulting into cross linked solid three-dimension viscous fluid suitable for the end use applications. Curing process improves the processability and enhances the mechanical properties of composites. Curing is irreversible and exothermic process. One of the important parameters during curing process is gelation time which is defined as the time required to achieve the non-flowing viscous resin from the initial liquid state. Gelation time varies depending upon the use of promoter and catalyst during the curing process.

Generally curing of Vinyl Ester resin is done with the help of cobalt naphthenate (Co 6%) as an accelerator and Methyl Ethyl Ketone Peroxide (MEKPO 55%) as a catalyst to initiate the free radical polymerization. When the ambient temperature is around 20-degree Celsius, appropriate dose of Dimethylaniline (DMA) is recommended. The purpose of DMA is to fasten the curing reaction at room temperature and form a cured solid.



**Fig: Schematic representation of Uncured and Cured Vinyl Ester Resin**

**Key Challenges**

One of disadvantages of vinyl ester resin manufacturing process is use of styrene, which is a toxic volatile organic compound. A special care is taken while using styrene monomer during the vinyl ester resin manufacturing process so that it is not exposed to outside environment. Exposure to styrene can cause skin irritation, rash, dryness. It can also irritate eye, nose, and throat. Additionally, prolong exposure can hamper concentration, memory and may affect brain and liver functions. According to Environmental protection Agency (EPA), It is listed under hazardous air pollutant and may be a potential carcinogenic substance as it has been found to cause lung cancer in animals. Studies have been conducted to find substitute of styrene such as vinyl derivatives of benzene and methyl acrylates. Further, efforts have been made to find novel monomers by using renewable feedstocks such as lignin, fatty acids, and carbohydrates.

**4.1.3. Process Flow Diagram**

**Vinyl Ester Resin Manufacturing Process Based on Liquid Epoxy Resin (Bisphenol – A)**

**Condenser**

**Unsaturated monocarboxylic acid1, Additives**

**Reactor**

**Temp :160-170°C**

**Time :4-6 Hr**

**Liquid Epoxy Resin (Bisphenol – A)**

**Styrene Monomer**

**Blender**

**Temp:70°C**

**Time: 2-4 Hr**

**Finished Products ready for packing**

*Source: TechSci Research*

**Vinyl Ester Resin Manufacturing Process Based on Solid Epoxy Resin (Novolac)**

**Condenser**

**Solid Epoxy Resin (Novolac)**

**Unsaturated monocarboxylic acid1, Additives**

**Reactor**

**Temp :160-170°C**

**Time :4-6 Hr**

**Styrene Monomer**

**Blender**

**Temp:70°C**

**Time: 2-4 Hr**

**Finished Products ready for packing**

*Source: TechSci Research*

*1 Unsaturated monocarboxylic acid include acrylic acid, methacrylic acid, crotonic acid, monoesters of unsaturated polycarboxylic acids, and monoesters of maleic acid. The unsaturated acids and monoesters may be used singly or as a mixture of two or more of them. The unsaturated monocarboxylic acids can be derived from renewable sources like lignin or soyabean oil therefore, the name bio- based vinyl ester resin is used.*

*2 Curing of vinyl ester resin is done by the end user industries according to the application in which it is used. Curing defines the gelation time of vinyl ester resin. Curing is a process that is employed to change the viscosities of the epoxy resin according to the customer's requirement. This process is completely optional and varies from manufacturer to manufacturer depending on the grade of VER to be manufactured.*

**Process Flow Diagram**

Raw material storage and handling

Reaction

Blending

Intermediate storage

Finishing

Finished product storage and handling

Bulk

Storage

Finishing

Tank

Storage

Blender

Reactor

Non- bulk

* Tank
* Truck
* IBC
* Drums

*Source: TechSci Research*

*Source: TechSci Research*

Room Temperature

Heating 95°C to 100°C1

Heating 160°C-170°C

*1. The temperature is gradually decreased from a range of 160°C-170°C to 95°C-100°C.*

**Standard Process**

One mole of bisphenol A was catalytically reacted with two moles of diglycidylether of bisphenol A at 150° C for two hours under atmospheric conditions. This yielded a polyepoxide resin having an epoxide equivalent weight of 500 (g/eq) which was subsequently cooled to 130° C. Next, two moles of methacrylic acid and 180 ppm of hydroquinone (based on finished product) were added under an air sparge and esterified at 120° C until an acid value less than 10 units was recorded. The vinyl ester resin was then cooled to 110° C and 0.05 moles of maleic anhydride were added. The vinyl ester resin was allowed to continue esterifying for 15 minutes at these conditions before thinning with styrene monomer to 65% non-volatiles and cooling to room temperature. This product is the control.

**Specialised Process (Low Epoxy Value)**

This vinyl ester resin was prepared the same way as standard process, except that 2.26 moles of methacrylic acid were used and the vinyl ester resin was esterified to an epoxy value (epoxy value EW is the reciprocal of the epoxy number and thus describes the number of epoxy groups that are contained in 100 g of resin) less than two units before cooling to 110° C and adding maleic anhydride. This product was thinned in styrene monomer to 65% non-volatiles and cooled to room temperature.

**Low Styrene Emission Vinyl Ester Resin**

The production of low styrene emission vinyl ester resin includes paraffin as a styrene emission inhibitor and a drying oil as an adhesion promoter for fibre-reinforced applications. It has been found that due to paraffin wax additives there is a substantial loss in the adhesive properties of the vinyl ester resin therefore adhesion promoter in the form of a drying oil is added.

**India Scenario of Vinyl Ester Process**

The standard process is majorly used in the country as the demand of the product is project based in which only blending is done in the reactor which involves no technology licensor. Indian Companies manufactures vinyl ester of INEOS’s quality like DerakaneTM. The specialized process is mainly used by western companies as they produce low epoxy and styrene free vinyl ester resin.

**4.1.4. Major Equipment List (List of major equipment in terms of value & importance)**

|  |  |  |
| --- | --- | --- |
| S No | Equipment | Tag No |
| 1 | Hopper | H-101 &102 |
| 2 | Crusher | T-101 |
| 3 | Condenser | S-101 |
| 4 | Vacuum Pump | VP-101 |
| 5 | Batch Reactor | R-101 |
| 6 | Epoxy Storage Tank | V-101 |
| 7 | Epoxy Transfer Pump | P-101 |
| 8 | Styrene Storage Tank | V-102 |
| 9 | Styrene Transfer pump | P-102 |
| 10 | Methyl Methacrylic storage tank | V-103 |
| 11 | Methyl Methacrylic Transfer Pump | P-103 |
| 12 | Jacketed Blender | B-101 |
| 13 | Packaging Equipment | PA-101 |

**4.1.5. Technology Licensor**

* Vinyl ester resins are downstream product of Epoxy Resin. Mostly manufacturing companies have their in-house technology and R&D facilities to make formulations.
* Major reactions are carried out with the help of batch reactor and blender which can be outsourced. For 30KTPA, 15 different size reactors of 1 to 20 tons to produce 45 tons per batch.
* Generally, manufacturing process involves mixing of feedstock material in batch reactor and blending with organic solvent such as styrene monomer.
* There is no technology licensor for the product. Indian manufacturing company Atul limited has vertically integrated Epoxy resin capacity and downstream integrated Vinyl Ester Resin capacity while other Indian players such as Innovative Resins, Satyen Polymers, Mechemco Resins among others have in-house batch reactor set up. However, they import feedstocks Epoxy resin, Bisphenol-A, and other additives from the domestic or international market.

**4.1.6. Utilities Overview (For a 30 KTPA plant)**

**Energy/power Requirements**

* Total connected load is 1000 KW which is sufficient to carry out proposed vinyl ester resin manufacturing activity.

**Fuel**

* LDO will be used as fuel in Thermic Oil Heater with quantity 352 Lit./Hr. Electricity will be used in reactors.
* Diesel will be used to run the D.G. set, if needed.

**Water Requirement**

* Total water requirement will be 5 KL/day for the vinyl ester resin plant which will be used in cooling. There is no use of any water in vinyl ester resin manufacturing process.

|  |  |  |  |
| --- | --- | --- | --- |
| **Sr. No.** | **Usage** | **Water consumption (KL/Day)** | **Wastewater generation (KL/day)** |
| 1. | Processing | 0 | 30 |
| 2. | Cooling | 5 | 0 |
|  | **Total** | **5** | **30** |

*Source: TechSci Research and EC Report of Innovative Resins Pvt. Ltd.*

**4.1.7. Waste Generation, Management, and Disposal**

**Hazardous Waste Management**

The proposed plant will generate the following hazardous wastes

|  |  |  |  |
| --- | --- | --- | --- |
| **Sr. No.** | **Name of the Waste** | **Source** | **Mode of Disposal** |
| 1 | ETP Sludge/Evaporation Residue | ETP/ Evaporator | TSDF Site |
| 2 | Used Oil | Lubrication/ D.G.set | Reuse as Lubricant within premises. |
| 3 | Discarded drums/bags | Stores | Sold To Recycler |

*Source: TechSci Research*

ETP (Effluent Treatment Plant) sludge serves as the main source of hazardous waste generation from proposed activity. The other sources of hazardous waste generation from proposed activity includes spent or used oil generation from plant machinery and discarded barrel or containers from handling and storage of raw materials.

A dedicated storage area will be provided in the unit for the hazardous storage within premises having waterproof floor and roof cover.

**4.1.8 Raw Material Required and Key Suppliers in India Market**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **S. No** | **Raw Material** | **Supplier 1** | **Supplier 2** | **Supplier 3** | **Supplier 4** | **Supplier 5** |
| **1.** | Epoxy Resin | Grasim Industries Ltd | Atul Ltd. | Covestro AG | Huntsman  Corporation | Hexion Inc. |
| **2.** | Bisphenol-A | Atul Ltd. | Dow Chemical | LG Chem | Mitsubishi Chemical | Mitsui Chemicals |
| **3.** | Methacrylic Acid | Evonik Industries | Dow Chemicals | Formosa Plastics | Kusumoto Chemicals Ltd | Celanese |
| **4.** | Styrene Monomer | SABIC | INEOS Group Ltd | Hanwha Group | Royal Dutch Shell plc | Chevron Phillips Chemical |
| **5.** | Tri-Ethyl Amine | Balaji Amines Ltd | Alkyl Amine Ltd | BASF SE | Eastman Corporation | Dow Chemicals |

**Upcoming Developments in Technology**

**Bio-sourced vinyl ester resin:** New thermoset composite material made from cardanol-based resin blended with microfibrillar cellulose was compared to petroleum-based vinyl ester and glass-fibre reinforced unsaturated polyester in terms of mechanical, thermal, rheological and surface properties of produced polymers and composites. The bio-sourced material was less resistant than the commercial vinyl ester but comparable to the unsaturated polyester resin. Microfibrillar cellulose increased the tensile strength and modulus but increased the resin viscosity and decreased the mixture homogeneity.

**Styrene Emission:**

Due to growing health concern3, the styrene content has been greatly reduced in resin systems or completely replaced by less toxic vinyl monomers such as vinyl toluene, vinyl acetate, or methyl (meth)acrylate as well as by difunctional vinyl monomers such as diacrylates and dimethacrylates.

**5. Economic Evaluation**

**5.1 Estimated Investment:** For the suggested capacity of 30 KTPA, overall investment is USD 10.8 million. The exchange rate is considered USD 1 = INR 73.30. Considering current volatility in commodity cycles and exchange rate, capital expenditure for the project may increase by 10-12 percent if project is implemented by near future.

**5.2 Fixed Cost & Variable Cost Analysis:**

In particular, the total capital investment was based on the percentage of the delivered equipment cost method for a processing plant.

The total cost of the process equipment (including auxiliary equipment) as the 100% value, the total capital investment for the base case is estimated at USD 34.1 million.

|  |  |  |
| --- | --- | --- |
|  | **ITEM** | **[USD Million]** |
| **A** | **TOTAL FIXED-CAPITAL INVESTMENT** | 10.56 |
|  | **TOTAL DIRECT PLANT COST** | 7.69 |
|  | **TOTAL INDIRECT PLANT COST** | 2.86 |
| **B** | **WORKING CAPITAL** | 0.22 |
|  | **TOTAL CAPITAL INVESTMENT** | 10.78 |
|  |  |  |

**5.3. Machinery & Equipment Cost Analysis:**

The total cost of the equipment is approximately USD 2.73 Million including the auxiliary equipment. Being exothermic reaction process, product is process parameter sensitive (consistency need to be maintained), hence considering the reactor and Blender as a complex part of the Production, therefore are considered as auxiliary equipment. construction material is SS 304. The client is preferred to consider whole plant both manually & automated. The equipment cost might vary for different manufacturers depending on the complexity and the material of construction. Construction and Installation of large size equipment (volume more than 100 m3) like LER Storage Tanks, Styrene is done on-site as the transportation of such equipment is not feasible.

**Assumptions:**

1. Each tank will have pump in its downstream section.
2. Continuous Process.
3. In one Reactor more than one number of grades can be formed.
4. Considered Equipment Cost will be ±20 -25 % accurate.
5. Batch Reactor and Jacketed Blender considered as auxiliary or proprietor equipments.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | | | | |  |
|  | **MAIN PROCESS EQUIPMENTS** | **CAPACITY** | **UNITS** | **Unit Rate**  **[USD million]** | **Category** |
| 1 | Hopper | m^3 | 2 | 0.027 | Indigenous |
| 2 | Crusher | kg/hr | 4 | 0.355 | Indigenous |
| 3 | Condenser | m^2 | 1 | 0.044 | Indigenous |
| 4 | Vacuum Pump | m^3/h | 2 | 0.082 | Indigenous |
| 5 | Batch Reactor | m^3 | 2 | 0.266 | Auxiliary |
| 6 | Epoxy Storage Tank | m^3 | 2 | 0.195 | Indigenous |
| 7 | Epoxy Transfer Pump | m^3/h | 4 | 0.041 | Indigenous |
| 8 | Styrene Storage Tank | m^3 | 2 | 0.222 | Indigenous |
| 9 | Styrene Transfer pump | m^3/h | 4 | 0.053 | Indigenous |
| 10 | Methyl Methacrylic storage tank | m^3 | 2 | 0.177 | Indigenous |
| 12 | Methyl Methacrylic Transfer Pump | m^3/h | 4 | 0.044 | Indigenous |
| 13 | Jacketed Blender | m^2 | 2 | 0.355 | Auxiliary |
| 14 | Feed Pump | m^3/h | 6 | 0.115 | Indigenous |
| 15 | Dust Collector | m^3/h | 3 | 0.071 | Indigenous |
| 16 | Product Tank | m^3 | 3 | 0.532 | Indigenous |
| 17 | Packaging Equipment | KG/bag | 3 | 0.150 | Indigenous |
|  | **TOTAL MAIN EQUIPMENT COST** |  |  | **2.73** |  |

**5.4. Annual Cost of Production**

Raw Material Cost is considered as the base case, the annual cost of raw materials reached a value of USD 61.7 Millionper year for 30 thousand tonnes per annum plant capacity. Major raw materials considered are Epoxy Resin, Bisphenol A, Styrene, Methacrylic Acid with stoichiometry ratio of 0.3, 0.14, 0.45 & 0.11 respectively.

|  |  |  |  |
| --- | --- | --- | --- |
|  | **ITEM** | **[USD Million]** |  |
| **C** | **Manufacturing Cost** | 63.33 |  |
| **C1** | **Raw materials** | 61.71 |  |
| **C2** | **Labour** | 0.57 |  |
| **C3** | **Variable Overheads including Utilities** | 1.05 |  |
| **D** | **Fixed Overheads** | 1.45 |  |
| D1 | Maintenance and repairs | 0.53 | Fixed |
| D2 | Operating supplies | 0.08 | Fixed |
| D3 | Laboratory charge | 0.07 | Fixed |
| D4 | Plant Overhead Cost | 0.66 | Fixed |
| D5 | Administrative Cost | 0.11 | Fixed |
| **E** | **Selling Overheads** | 8.42 |  |
|  | **Total Production Cost (C+D+E)** | **73.20** |  |

*\* The Overall Cost accuracy is ± 25-30%.*

**5.5. Payback Period:**

The payback period is an effective measure of investment risk. It is the number of years it would take to get back the initial investment made for a project. Therefore, as a technique of capital budgeting, the payback period will be used to compare projects and derive the number of years it takes to get back the initial investment. The project with the least number of years usually is selected.

The data has been sourced from extensive primary and secondary research which includes published documents, annual reports, journals etc.

|  |  |
| --- | --- |
| **PROFITABILITY PARAMETER** | |
|  | **Value (USD Million)** |
| **NPV @ 10%** | 31.40 |
| **Internal Rate Of Return (%)**  ***On Total Capital -*** ***Before Taxes*** | 50.02% |
| **Payback Period, Years** | 2.36 |
| Simple | 2.51% |
| Discounted @ 12% | 3.46% |

**Assumptions-**

1. Cost of Capital will be assumed as 10%
2. Tax rate will be assumed as 30%
3. Amortization will be presumed to be in next 10 years on equal basis.
4. Accounts Receivables will be taken as of 60 Days.
5. Accounts Payables will be taken as of 60 Days.
6. Inventory will be taken as of 30 Days.

**5.6. Project Sensitivity Analysis:**

Project sensitivity is a holistic evaluation of how likely it is that a project will succeed through data-driven forecasting. It also identifies risks, quantifies their impact, and separates high-risk tasks from low ones. Project sensitivity is defined by both a written analysis and a mathematical formula that includes average task durations based on past data, simulated durations based on hypothetical models, and an average task duration for both of those projections.

1. IRR is highly attractive
2. Project is moderately sensitive to variations in Investment and highly sensitive to Selling Price as also the Feedstock prices. Relative sensitivity, in decreasing order is:
   1. Selling Price (i.e., Revenue)
   2. Feedstock Prices (i.e., Raw Material Costs)
   3. Investment (i.e., Capital Cost)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| ***NPV in USD Million*** | | | | | |
|  | BASE CASE | 90.00% | 95.00% | 105.00% | 110.00% |
|  | **CAPITAL COST** | | | | |
| IRR% | 50.02% | 54.25% | 52.04% | 48.16% | 46.44% |
| NPV | 31.4 | 32.02 | 31.7 | 31.1 | 30.79 |
|  | **REVENUE** | | | | |
| IRR% | 50.02% | 27.48% | 39.23% | 60.22% | 70.04% |
| NPV | 31.4 | 10.6 | 21 | 41.8 | 52.2 |
|  | **RAW MATERIALS COST** | | | | |
| IRR% | 50.02% | 63.99% | 57.09% | 42.71% | 35.09% |
| NPV | 31.4 | 45.8 | 38.6 | 24.2 | 17.1 |

**6. Project Schedule:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **PROJECT IMPLEMENTATION SCHEDULE FOR EPOXY RESIN PLANT** | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Activity** |  | **Month** | | | | | | | | | | | | | | | | | | | | | | | |
|  | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 18 | 16 | 18 | 22 | 24 | 26 | 28 | 29 | 30 |
| 1. Kick Off Meeting, Detailed Engineering and Licensing |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **1. Civil Work** | | | | | | | | | | | | | | | | | | | | | | | | | |
| Company Registration |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Land Acquisition |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Finalisation of Building Design |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Invitation of Tenders and Award |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Factory Shed |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Auxiliary Building |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Administrative Block |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Other Construction |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Disbursal of Finances |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **3. Plant and Machinery** | | | | | | | | | | | | | | | | | | | | | | | | | |
| Specification Detailing |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Invitation of Quotations |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Placing Orders |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Delivery at Plant Site & Inspection |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Installation and Commissioning |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Check-up of the Plant & Machinery |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **4. Arrangement of Power/Water** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **5. Other Items** | | | | | | | | | | | | | | | | | | | | | | | | | |
| Finalize Management Reporting |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Finalize Official Practices |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Executive Systems |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **6. Training and Personnel** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **7. Start -up/ Commercial Production** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

The demand of vinyl ester resin is totally project based therefore the operating rate has been taken as per industrial norms. Due to its diverse application in specialised products, the demand is anticipated to further increase therefore, the plant can operate at a maximum of 70%. As per the Industry practice, in the same reactor other UPR can also be produced, therefore it cannot operate at an optimum capacity i.e., between 85% to 95%. The same applies for Reliance Industries Ltd.

**7. Project and Business Risk on setting up Vinyl Ester resin plant in West Region of India**

* **Cost Escalation-** There may be cost escalation and time overrun due to Covid-19 pandemic-related challenges, unusual rise in commodity prices and land conversion issues. It may also face cost overrun due to increase in foreign exchange component, increase in cost towards storage and preservation of equipment and interest during construction (IDC). As commodity prices like crude oil, steel, natural gas, coal & electricity are increasing which will be impacting the overall cost of the project. As per industry experts, the bullish market for the next few months will be noticing the upward trend in the commodity prices.
* **Domestic/ Geo-Political scenario-** In western India, Gujarat, Maharashtra, and Madhya Pradesh are three major states. Gujarat is comparatively more stable government and Maharashtra and Madhya Pradesh witnessed change in government in last 5 year. In Gujarat too, there may be anti-incumbency may prevail in coming election. The political scenario will not be much impacting the project and business as government majorly focuses on industrial development. Reliance as a brand is considered as the major contributor for the socio-economic growth of any state.
* **International/ Geo-Political Scenario-** India is not immune to geo-political scenario prevailing all over the global. In recent years, the following points have impacted the geopolitical scenario of India-
* The conflict among GCC (Gulf Cooperation Council) nations have impacted the prices of commodities.
* The trade war between US – China have impacted the export market.
* The natural calamities like Hurricanes, Floods are prevalent in the western region which hampers the export market.