REDEFINING
OPPORTUNITY FOR THE SILICONE INDUSTRY

Dr. Ravindra Kulkarni, Managing Director, Elkay Chemicals Pvt. Ltd. delves into how COVID-19 pandemic has created opportunity for the silicone industry. With redefined hygiene guidelines, silicone surfactants and additives will play an important role in designing disinfection systems, formulations and surface coatings in the future.

BY DEBARATI DAS

Global trends in the silicone industry.

Silicone industry was born towards the end of WW IT as a material used to create high performance grease for lubricating crucial military hardware. Since then, the industry has expanded multifold into both common and high-end performance applications. These were to be the first commonly available non-carbon polymers and had several unique attributes as a material.

Over 7000 products have evolved since then as high performance additives in diversified industry segments such as textile finishing agents, petroleum refinery additives, agricultural adjuvants, construction chemicals and sealants, paints and coatings, rubbers, plastic and rubber release agents, medicament, pharmaceutical intermediates, personal care hair and skin case additives, high performance foam stabilizers and destabilizers. All this adds up to an industry size of $20 billion worldwide and about $400 million India wide. The total tonnage of production, during the year 2019, was around 2.6 million MT globally and 0.12 million MT within India. The industry growth is about 5.4 percent globally and 15 percent within India. In general, the silicone business is majorly a performance chemical business, and has grown twice the rate of GDP growth and supports the enhancement of general quality of life. There are several growth segments within the silicone industry that will make sure of its continued expansion over the next couple of decades. These include:

a. Personal care – Silicones have a high level of biocompatibility and coupled with the extra sensory feel makes these a preferred choice for various personal care products. Specifically, the demand for odorless, safe propellants like D5 could grow much faster as it appears to be a material of choice having very few regulatory constraints.

b. Silicone elastomers – Specifically, Liquid Silicone Rubber (LSR) is becoming the material of choice for the manufacture of intricate parts with high precision requirements. LSR is not only dimensionally more accurate but also convenient to process. Growing sectors for these are electrical vehicles, FMCG goods and home goods.

c. Textile finishing – This sector, though forty years old, still exhibits a strong potential for growth. While most of the world has shifted to functional silicone based finishing agents, India is still far behind and would play a catch-up game that would eventually drive demand for functional silicones. Newer multifunctional silicones, known as hydrophilic silicone softeners, are rapidly replacing traditional functional silicones, while offering superior

textile finishes. Technical textiles are also using more and more silicones.

d. Agro-adjuvants – Silicone super spreaders are finding rapid acceptance as preferred choice of spray and surface penetrant additive that enhances effectiveness of pesticides multifold. Their applications are expanding from spray additives to supply of micronutrients to the plants to more efficient water management for plants and soil which is a growing requirement.

e. Construction – Silicones are the preferred choice of material for long term control of water in the building structure. Silicones being highly stable, weather resistant, inert and highly water repellent find excellent application in weather proofing of building exteriors, water absorption in concreate, crack minimization in plasters, water sealing of bathrooms, tubs and water tanks. The most basic use of silicone is as sealants that retain and hold glass panels in various modern buildings.

Potential for silicones in India & Asia Pacific.

Asia Pacific and India are one of the fastest growing geographies within the Silicone global industry. This growth is led by - Increased high quality construction in the region, rapidly growing standard of living and higher GDP growth rates; Higher use rate of personal care and cosmetic products; More advanced agriculture farming techniques; Shift towards electric vehicles where silicone rubbers can fulfil demanding needs; and Increased consumption of textile and products related to quality of life.

All these will add up to higher requirements for functional silicones, performance sealants and LSRs. Market annualized growth is expected to be 7.5 percent for Asia pacific and about 15 percent for India.

Factors hampering the silicone market growth.

Manufacturing of silicone-based products rests on three basic raw materials – methanol, silicon metal and energy. All these three items are related to crude oil cost which vary depending upon global crude oil demand and political stability. At present we are witnessing COVID19 induced decline in the demand of crude and resulting decrease in crude pricing. Environmental compliances have driven the price up somewhat recently, but this has now plateaued. With emergence of alternate energy options, the dependence of the global industry on crude oil is decreasing rapidly and the proliferation of electric vehicles will further dampen the price of crude oil. Thus, the fear of silicone price increase could not be from the cost of input raw material cost, but from the supply-demand imbalance. It should be noted that while Asia Pacific and India will lead the silicone consumption growth rate, it will need to import basic silicones from other countries such as China & Europe. This will create imbalanced movement of goods. Except for Thailand, there are no silicone basic manufacturing plants in the region.

Thus, creation of basic silicone plant in this region is a must for price stabilization and unabated growth in the industry. This could lead to excess availability of silicone in lower growth rate regions such as Europe.

Thus, while silicones prices will increase in proportion to normal trades in performance chemicals industry, it is unlikely to increase disproportionately to limits its growth.

It is not easy to replace silicone performance by traditional organic materials as the performance leverage offered by silicones are unmatched by traditional organics. However, unreasonable pricing could make its use unrealistic.

Overall, it is expected that the prices of silicones will increase over the next 5 – 10 years but the increase will not be large enough to limit its own growth.

Silicone, a better alternative for plastic products.

Silicones are inherently more expensive than traditional plastics. Thus, replacement of plastics by silicone is possible only on the basis of performance. Thus, every application, where performance can justify cost, a replacement is possible.

Some of the key leverages that justify replacement of plastics by silicones would be: Dimensional accuracy (more complicated parts become easy to make); Chemical stability, inertness; Longer lasting; Ease of manufacturing; -High and low temperature stability (-50 to 250 C); Mechanical/electrical properties; Biocompatibility and sterilization; and Recyclability.

If these leverages offered by silicones justify the higher cost then replacement is possible. Electric car connectors are one example where silicone can justify their entry. Electronic protective coatings, high performance molded parts used in kitchens, bakeware and food processing applications are some other recent examples.

For many cases new business applications that are not possible with traditional plastics become possible with silicones. These will include newer kitchenware, medical devices, auto-parts, water control in construction and infrastructure projects and related applications. Longer lasting functional silicone coatings also are showing a growing trend in paints, polishes and textiles where safety and durability justify the replacement of traditional binders.

Impact of COVID-19 pandemic, global lockdown on silicone industry.

Direct impact of COVID-19 on silicone industry would be lower level of demand than expected. It is estimated that Silicone demand could go down by 10 percent during the current year and could take two years to fully recover. This will have direct impact on capital investment plans within the industry.

With the COVID-19 emergence, humans will be revising their sanitation and hygienic habits. This is similar to a step change that occurred during 1918 Spanish flu pandemic. During this time, a series of disinfection products and chemical components were discovered and commercialized that are still playing a key role in public as well as domestic hygiene.

With COVID-19, an additional level of discoveries and commercialization of new technologies will be introduced that will take hygiene at public places and at domestic level to a new height. Two new fundamental hygiene points come in the front line which are viral spread in air (aerosolized) and viral spread through surface contamination.

New surface coatings that resists spread of microbial and viral infections will be introduced that may also include longer lasting disinfection.

Future building air flow designs may be dramatically different than present ones in terms of air flow from bottom to top to minimize aerial infection. This will change overall design of air handling systems and would have cost implications.

Chemical disinfection, along with UV disinfection, will take prominence and a series of new products that will offer microbe free living will become possible.

Silicone surfactants and additives will play important roles in designing disinfection systems, formulations and surface coatings. These products are UV stable, generally human safe, have properties that allow them to coat any surface (unlike organics) and can perform at very low dosages.

Silicone elastomers with sterilizing capabilities will get higher visibility as material of choice and see expanded business opportunities.

Impact on raw material availability in the current COVID-19 pandemic situation.

Silicone industry operates at three levels –

Basic integrated silicone manufacturing where silicon metal is converted into silicone monomers through the reaction with methyl chloride. Here the most basic raw materials are silica (sand) and methanol (by-product from the petrochemical industry). In addition, this conversion is energy intensive and thus accounts for a significant portion of its cost. Handling chlorine is a challenge.

Intermediate manufacturers that create a diversified range of silicone components suitable alone or for uses in formulations.

Formulators and distributors who purchase varying quantities of various specialized intermediates and create application specific products and formulations and service various industries.

While there are a handful of basic manufacturers, located in select places around the globe, there are 40 – 50 intermediate manufacturers across the globe and thousands of formulators, spread over the regions, servicing specific end applications.

Basic manufacturers are large and hold the capability to ensure availability of raw materials for themselves. With the current trend of lower crude oil prices, methanol and energy costs will remain stable to the lower side and thus will not cause pressure on silicone monomer prices. Silicon metal may remain under pressure as it is shared with solar energy industry that is growing rapidly and may divert silicon metal. Besides, major source of silicon metal is China and its supply will dictate pricing.

There remains the likelihood that companies would like to diversify their supply chains in geography and remain less dependent on China which manufacturers over 40 percent of today's basic siloxane.

Even with the longer-term effects of the pandemic, silicones do remain likely to continue to grow since they have marginal uses in the larger hit industries like aviation, tourism and steel. Construction and auto may take some time to recover but should recover none-the-less.

In summary, although the prices may fluctuate, but availability of silicone monomer across the globe will remain okay. Over the next decade the total demand for siloxane will increase by over million MT and industry will grow to meet that demand. If industry indeed accepts the challenge and brings such new capacity on board, the prices will increase marginally and demand -supply will be maintained.

However, it is expected that the new capacity would come in Asian countries such as India and possibly the MIDDLE EAST as that is where the most demand will be generated and allow supply chains to remain non-reliant on a single country.

Overview about the company's silicone business.

Elkay Chemicals Pvt Ltd, has three manufacturing facilities within India and manufactures a variety of silicones products as listed below;

Silicone fluids of standard as well as custom specifications are manufactured and supplied globally. This includes fluids with viscosity ranging from 10 to 2 million centipoise; and special application dependant specifications such as electrical breakdown potential; molecular distribution; refractive index and high temperature thermal stability. Elkay supplies products that have customized specifications as stated above along with normal standard products. These products are demanded by range of industrial applications ranging from mold release, industrial polishes, heat transfer fluids, personal care, medicaments, pharmaceutical, insulation and lubrications.

Functional Silicones – This series of products again range from standard products to any customized products with tailored specifications. This includes variation in functional groups from Amino, epoxy, hydroxyl, alkoxy, vinyl to any combination of these functions. Variations also includes, viscosity, refractive index and so on. These variations are desired by industry specialist for their own customer formulations for paints, coatings, textile finishing, inks, personal care and any other highly specialized applications specific to customer.

Silicone antifoams – Elkay supplies antifoam and deformer compositions to diversified industries ranging from standard general application defoamer to highly customized application specific formulations. Most of these antifoams are based on activated Silicone fluids with specific additive technology to suit end application needs. Industry served includes, waste water treatment, desalination, distillations, paints, coatings, inks, etc.

Silicone Emulsions – Broad range of Silicone emulsions are offered originating from above three business segments, Silicones fluids, functional fluids as well as antifoams are offered to customers as neat compounds or as their respective emulsions or end formulations suitable for their specific bath conditions. Thus, company offers a full range of emulsification technology platform to suit standard as well as specific needs. These includes, micro-emulsions; Nano-emulsions etc.

Specialty Silicone – Broad range of highly specialized and customized products based on state of the art Silicone manufacturing processes that includes silicone surfactants, resins, and formulations offering solutions for petrochemicals processing; potting for electronics, agro-adjuvants, water proofing and weather protection construction coatings.

Company's focus on R&D and innovation.

Our biggest innovations are in the field of new generation textile finishing agents based on hybrid silicone copolymer that chemically combines amine functionality with hydrophilic components, leading to a highly stable molecule that promise superior comfort to user and a simpler process to applicators. These molecules and formulations are already in the market and their value has been demonstrated. Their volumes are expected to multiply in the coming decade.

LSR technology is one of the front running technologies that would potentially not only replace plastic parts but also offer opportunities for newer parts not possible in the past. Key leverage offered is process simplicity, accuracy and dimensional stability. All these characteristics add up to a superior attractive design at affordable price. Specific case in point will be use of parts for electric vehicles.

Development of application specific super spreader formulations that would be tailor-made to specific crops and farming conditions.

Incorporating sustainability in silicone products and processes.

Sustainability in chemical industry refers to recycling, reuse and rework. It also refers to ensuring eco-sensitivity and environmental compatibility. Silicone products, being performance products and additives, form a small portion of the overall product (1 to 5 percent) and thus have a dramatic dilution effect. Thus, for most part it's recycling from such diluted products is complex and not practical. Out of some 7,000 products that are sold 85 percent of them are used in the end product as additives. Remaining 15 percent are used where silicones are the primary component and thus are amenable for recycling. Thus, recycling is possible if a proper collection and transportation

to recycling center is possible. In most developed and developing countries, every individual put about few gram of silicone over his/her body, through, shampoo, conditioner, soaps, polishes, softeners, fabric enhancers etc. None of these smaller quantities could be recovered in any form. All these parts eventually get drained into rivers as effluents and thus are not available for recycling.

Fortunately, silicone is environment friendly material and is bio-compatible. Its presence in atmosphere neither harms ozone layer, nor does it hurt ecology.

In summary, silicones are eco friendly, have excellent biocompatibility and are environmental friendly materials and thus support sustainability.

It is important to note that whatever silicones could be collected in bulk scrap is recycled (about 2 percent of production) effectively adding to the overall sustainability model. These silicone recycling centers are located mostly in Asia. Two in India, one in Vietnam and few in China. These companies, together account for majority of silicone recycling.

Challenges faced by silicones manufacturers globally.

As stated earlier, silicone industry is truly a globalized industry. While applications and users are all across globe, the basic monomer production is limited to only few countries, namely, USA, Germany, UK, Japan, China, Korea, Russia and Thailand. Monomers, polymers and semi-finished products are transported from these limited production areas to large number of global destinations. These are than further processed and redistributed globally. Similarly, the basic raw material silicon is sourced from few locations in the world, namely China, USA, Russia and some parts of Europe. Thus, healthy global trade is the basic requirement for the healthy silicone industry. Tariffs, restrictions and shipping play a crucial role in the stability of this industry.

Silicone industry is growing at 2X of GDP globally. It requires one new plant addition each year. This is indeed a challenge. Health of the industry is crucial for continued investments in the basic plant to ensure stepwise capacity addition. Current stressed economic conditions brought about by COVID19 could put damper on the longer-term investment plans and could cause disruption in the industrial supply cycle. Silicon is the primary raw material for the silicone industry, however, this metal is shared by four separate industries – silicon photovoltaic devices, auto engines, specialty steel and silicone industries. All these are totally disconnected industries connected only by the use of silicon metal. Thus, supply–demand cycles for each of these industries are different and at times collide and cause unnatural swings in pricing and hence the overall health of the industry.

More uniform distribution of raw material sourcing and placement of basic plant will go long way in assuring steady supply of silicone and overall growth of the industry.

Global measures to ensure proper revival of silicone industry post COVID-19 pandemic.

The primary issue with the industry would be liquidity. Government of different countries must focus on providing enough liquidity so that the companies are able to continue business and are able to pay their creditors. This is the most crucial aspect of restart. If liquidity is not adequate, there could be bankruptcy chain reaction, which in turn could devastate the business. Thus, in a broader sense, the most crucial policy decision which government must make is to minimize bankruptcy. Once this is achieved, businesses would automatically recover over a period of time and prosper.

The second most critical government decision would be to incentivize consumption. This process will accelerate recovery of companies to a healthy position. In this regard, each country would have their own policies in line with their local requirements.

Silicone impacts overall quality of life and thus does not fall in the category of essential products and services. Thus, it is unlikely that any specific incentives would be offered to Silicone industry. However, general incentives would spread into Silicone industry and it would indeed benefit.

Silicone is one of the most significant globally traded and consumed product. Thus, free international trade is crucial for future success and smooth expansion of silicone business. Government must not create and implement policies that restrict international trade. Current trade practices, at least must be maintained to ensure continued global silicone business. On the other hand, any trade restrictions or extra punitive duties would severely impair silicone business.

Impact on economic development and the chemical industry in general due to COVID-19.

Chemical industry is broad based and distributed across the globe. This $4 trillion industry has significant implications to world trade and economy. India represents roughly $100 billion revenue (2.5 percent of global revenue) and $26 Billion of exports. However, over the past one decade, industry is systematically shifting away from North America and Europe to China and Asian countries. As of the year 2018, 67 percent of chemicals are now manufactured in China/Asian countries and 33 percent is distributed among Europe and North America. This has a direct impact on the transportation, supply chain and logistics issues related to chemical usage. This has resulted in a large-scale transport of goods from Asia to Europe and the US.

COVID-19 has three major impacts on the global chemical business. These include

- Crippled liquidity and cash flow
- Imbalance in demand supply and
- Financial implications, including future capital investment.

In the short term, demand for certain chemical segments have gone down and some select items that impact COVID-19 operation have gone up. Lockdowns have resulted in closure of some plants, while some are operating at significantly lower levels. This is due to manpower shortage or shortage of key raw materials or simply lower product demand. Lower level of plant operation would result in financial losses and constrained cash flow.

Certain lowering of demand may look temporary but some others, such as demand from the auto sector or leisure industry sector, could be medium to longer term.

In addition, as stated above, much of the industry depends upon supply of input chemicals from China and Asian countries. These supply chain could see disruptions. The nature of the industry is such that even if one chemical item is missing it could bring the full plant to a halt. Thus, COVID-19 induced supply disruption could play a disproportionately higher impact on chemical business.

Amidst current global trade environment, ways to ensure raw material availability for the industry.

Global chemical business is multidimensional and requires a complex network of distribution and logistics. Over the years, these plants have grown bigger in size and have integrated in the supply chain logistics consisting of warehouses, distribution centres and transportation hubs. Many chemical users rely on just in time type inventory management and local transportation to reach the point of application. This is also partly required

by storage and regulatory norms that restricts storages. Environmental laws and regulatory requirements necessitate the growth of the chemical industry to concentrate in clusters. COVID-19 driven lockdown has forced closure of most of the chemicals plants globally. Few are operating under essential goods and services. However, even there plants are facing severe supply problems. International shipping is operating at limited levels and causing delays in supplies. Most shipping ports are operating with minimum staff, resulting in long delays in clearances and delivery of chemical shipments.

Major delays and supply constraints come from international shipments and its last mile connectivity. As of year 2018, over $1.55 trillion worth of chemicals were transported across nations to reach application destinations. Delays in supply not only impact chemical business but also non chemical business where chemicals are used in smaller add on quantities such as electronics, cables, etc.

These delays and supply constraints will continue till COVID-19 comes under control. As of now it is not clear as to how COVID-19 is going to play out. It may take a few months or a year or longer.

Supply chain management and logistics have to integrate into COVID-19 reality, this may include change in cost structure. Added cost could require new cost reality and consequent restructuring of distribution and manufacturing network. In the longer run, some of the manufacturing as well as distribution may get restructured to adjust to the new reality. Current trade reality may influence the role of China as a major supplier and exporter of chemicals. However, it is unlikely to result in a shift of industries back to Europe or America. It is more likely to get distributed within Asia, so that more goods could get manufactured in Vietnam, India or Indonesia and transported back to the point of application. It is important to note that all that is stated above will not impact all chemical business uniformly. Some of the petrochemical businesses, dominated by America, could get back on their feet much faster.

Another point to be taken under consideration is that the chemical businesses have multiple product lines integrated and bunched up together. At present most of these products are dynamically balanced though a delicate pricing structure. COVID-19 will bring some imbalance in the supply-demand and would disturb this balance and would result in a revised pricing. As an example, the petrochemical industry has diversified products that are currently being used in certain ratios. COVID-19 has dramatically increased polypropylene usage due to personal protective wear, while use of polyethylene may go down. Similarly, the use of surfactants will go up due to excessive hand washings, while use of butadiene-based products may go down in volume.

Suggestions to help the industry get back to its growth momentum.

Majority of chemical industrialists agree that the single most important impact of COVID-19 would be in corporate cash flow and overall liquidity. This is due to a stoppage of the business for 1–3 months depending upon the location. In addition, businesses are unlikely to return to normal in a relatively short time. Demands would be low and will improve slowly as the situation returns to normal. This could take one year or more. It may lead to layoffs, delayed payments, and several related financial crises. It is highly advised that the single most support government could offer would be easy availability of funds at reasonable terms.

From Indian chemical industry viewpoint, it is crucial that we find ways to attract chemical industries that wish to exit China or who wish to create an alternate option to China. To do so it is important to create stand-alone zero discharge green chemical parks, distributed across the country. These parks will ensure pollution free chemical production by offering centralized utilities (steam, hot oil, Nitrogen, compressed air, water and pressurized water for fire safety, power etc) and services such as water treatment plants, maintenance engineering services, dedicated Fire brigade, centralized laboratory, safety, scrubbers etc. Such facilities will have multiple positive effects such as minimization of capital and operating costs (shared cost); lower pollution level and most importantly fast track decision making. In addition, one can offer nearby housing colonies and bussing arrangements.

These parks will attract small to medium size enterprises and dramatically increase national manufacturing capabilities. Most importantly it will attract a large number of companies as an alternative to China. They will be cost competitive and could stand up to the global pricing challenges. Such a structure would bring global cost competitiveness and would offer India a much-needed position of dominant global supplier of chemicals.