India's International Trade of Four Specific Commodities in the Recent Past

Some Insights

Preface

The study uses trade indicators to analyse merchandise export and import data in a way that should be useful for the purpose of policy. The indicators provide a glimpse of the trade patterns of the world and the performance of India in comparison to various other countries. They have been used in the case of India's exports of **Starches ; Inulin & Organic Surface Active Agents** and imports of **Copper fittings and Quaternary Ammonium Salts and Hydroxide** to indicate the possible directions policy may take.

The data used in this study has been sourced from the Export Import Data Bank of the DGCI&S, Department of Commerce, and Government of India and from the United Nations Comtrade Database. Introduction notes of each commodities has been sourced from the various sights –viz Wikipedia, Britannica, The Economic Times etc.

Computations are based on data at ITC-HS four-digit level (ITC-HS Code-1108 & 3402 for export and 7412 & 2923 for import) and the latest finalized data available on the UN Comtrade Database up to year 2021 and on the DGCI&S Database up to November'2022. So, trends from 2018 to 2021 have been shown when we extract the data from UN Comtrade and from 2018 to 2021 have been shown when we extract the data from DGCIS Data base.

In this report, we will see various analysis and aspects of India's Precious as well as International export trade of Starches ; Inulin & Organic Surface Active Agents and imports of Copper fittings and Quaternary Ammonium Salts and Hydroxide. We will use both the 4 digit Commodity codes.

Trends in India's as well as International Trade i.e. Exports and Imports of above four Commodities are given below in different tables :

- Table 1 : India's top 10 Export destination of Starches ; Inulin with their shares in percentage.
- Table 2 : World's top 10 Exporters of Starches ; Inulin with their shares in percentage.
- Table 3 : World's top 10 Importers of Starches ; Inulin with their shares in percentage.
- Annex- I : Top 3 sources of Starches ; Inulin of World's top 3 Importers.
- Table 4 : India's top 10 destination of Organic Surface Active Agents with their shares in percentage.
- Table5 : World's top 10 Exporters of Organic Surface Active Agents with their shares in percentage.
- Table 6 : World's top 10 Importers of Organic Surface Active Agents with their shares in percentage.
- Annex-II : Top 3 sources of Organic Surface Active Agents of World's top 3 Importers.
- Table 7 : India's top10 Sources of Copper fittings with their shares in percentage.
- Table 8 : World's top 10 Importers of Copper fittings with their shares in percentage.
- Table 9 : India's top 10 Sources of Quaternary Ammonium Salts and Hydroxide with their shares in percentage.
- Table 10 : World's top 10 Importers of Quaternary Ammonium Salts and Hydroxide with their shares in percentage.

EXPORT

Starches; Inulin

Starch is a polymeric carbohydrate consisting of numerous glucose units joined by glycosidic bonds. This polysaccharide is produced by most green plants for energy storage. Worldwide, it is the most common carbohydrate in human diets, and is contained in large amounts in staple foods such as wheat, potatoes, maize (corn), rice, and cassava (manioc).

Pure starch is a white, tasteless and odourless powder that is insoluble in cold water or alcohol. It consists of two types of molecules: the linear and helical amylose and the branched amylopectin. Depending on the plant, starch generally contains 20 to 25% amylose and 75 to 80% amylopectin by weight. Glycogen, the energy reserve of animals, is a more highly branched version of amylopectin.

In industry, starch is often converted into sugars, for example by malting. These sugars may be fermented to produce ethanol in the manufacture of beer, whisky and biofuel. In addition, sugars produced from processed starch are used in many processed foods.

Mixing most starches in warm water produces a paste, such as wheat paste, which can be used as a thickening, stiffening or gluing agent. The principle non-food, industrial use of starch is as an adhesive in the papermaking process. A similar paste, clothing starch, can be applied to certain textile goods before ironing to stiffen them.

Starch grains from the rhizomes of Typha (cattails, bulrushes) as flour have been identified from grinding stones in Europe dating back to 30,000 years ago. Starch grains from sorghum were found on grind stones in caves in Ngalue, Mozambique dating up to 100,000 years ago.

Pure extracted wheat starch paste was used in Ancient Egypt possibly to glue papyrus. The extraction of starch is first described in the Natural History of Pliny the Elder around AD 77–79. Romans used it also in cosmetic creams, to powder the hair and to thicken sauces. Persians and Indians used it to make dishes similar to gothumai wheat halva. Rice starch as surface treatment of paper has been used in paper production in China since 700 CE.

Starch is the most common carbohydrate in the human diet and is contained in many staple foods. The major sources of starch intake worldwide are the cereals (rice, wheat, and maize) and the root vegetables (potatoes and cassava). Many other starchy foods are grown, some only in specific climates, including acorns, arrowroot, arracacha, bananas, barley, breadfruit, buckwheat, canna, colocasia, katakuri, kudzu, malanga, millet, oats, oca, polynesian arrowroot, sago, sorghum, sweet potatoes, rye, taro, chestnuts, water chestnuts, arrowroot and yams, and many kinds of beans, such as favas, lentils, mung beans, peas, and chickpeas.

The starch industry extracts and refines starches from seeds, roots and tubers, by wet grinding, washing, sieving and drying. Today, the main commercial refined starches are cornstarch, tapioca, arrowroot,[64] and wheat, rice, and potato starches. To a lesser extent, sources of refined starch are sweet potato, sago and mung bean. To this day, starch is extracted from more than 50 types of plants.

Untreated starch requires heat to thicken or gelatinize. When a starch is pre-cooked, it can then be used to thicken instantly in cold water. This is referred to as a pregelatinized starch.

As an additive for food processing, food starches are typically used as thickeners and stabilizers in foods such as puddings, custards, soups, sauces, gravies, pie fillings, and salad dressings, and to make noodles and pastas. They function as thickeners, extenders, emulsion stabilizers and are exceptional binders in processed meats.

In the pharmaceutical industry, starch is also used as an excipient, as tablet disintegrant, and as binder.

These are broadly classified under **H.S. Code-1108.**

Table - 1

India's Top 10 destination of Starches; Inulin (H.S Code-1108)

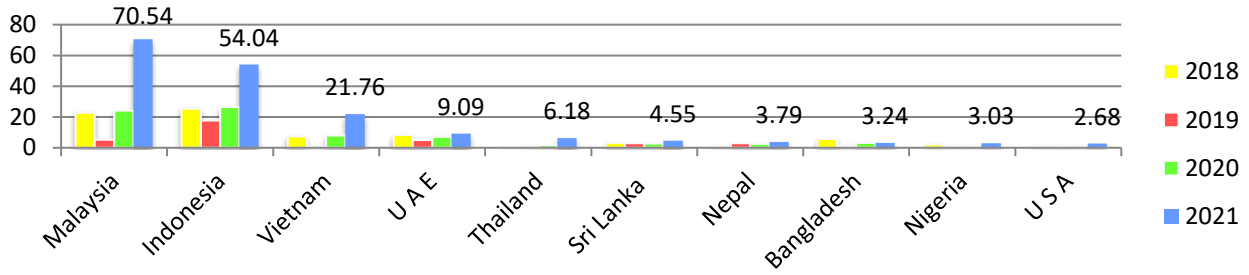
Rank	Countries	2018		2019		2020		2021	
		Value (million$)	Share (%)	Value (million$)	Share (%)	Value (million$)	Share (%)	Value (million$)	Share (%)
1.	Malaysia	22.65	23.28	5.13	10.37	24.25	26.37	70.54	36.12
2.	Indonesia	25.43	26.14	17.66	35.69	26.41	28.72	54.04	27.67
3.	Vietnam	7.41	7.62	1.09	2.20	7.97	8.67	21.76	11.14
4.	U A E	8.25	8.48	5.03	10.16	7.04	7.66	9.09	4.65
5.	Thailand	0.28	0.29	0.76	1.54	1.60	1.73	6.18	3.17
6.	Sri Lanka	3.12	3.20	3.03	6.13	2.83	3.08	4.55	2.33
7.	Nepal	1.26	1.29	2.95	5.97	2.52	2.74	3.79	1.94
8.	Bangladesh	5.63	5.79	1.23	2.49	3.17	3.45	3.24	1.66
9.	Nigeria	2.21	2.27	0.64	1.29	0.85	0.92	3.03	1.55
10.	U S A	0.92	0.94	1.25	2.53	1.32	1.43	2.68	1.37
	Others	20.15	20.70	10.71	21.64	14.00	15.23	16.40	8.40
	Total	97.31		49.48		91.96		195.28	

Source: DGCI&S.

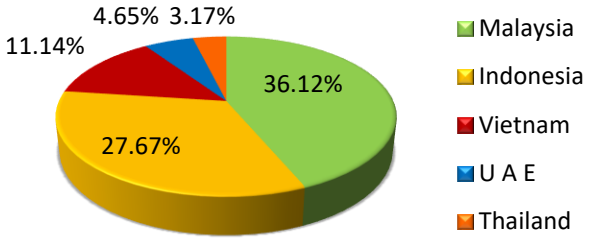
Note : India's Export including re-export

India's top destinations of Starches; Inulin from 2018-2021**(in million USD)**

Data label given on the basis of 2021



India's top 5 destinations of Starches; Inulin by percentage India in 2021:



The value of exports of Starches : Inulin from India totalled US $ 195.28 million in 2021 which was increased by more than 2 times in value terms compared to 2020. Malaysia, Indonesia and Vietnam were three major destination of Starches from India with 36.12%, 27.67% and 11.14% share of India' total export in 2021 respectively. It is noticeable that Indonesia was the largest destination of the commodity group from India from 2018 to 2020. India's export of the commodity group is hit for all time high of US $ 195.28 Million in 2021.

Table-2

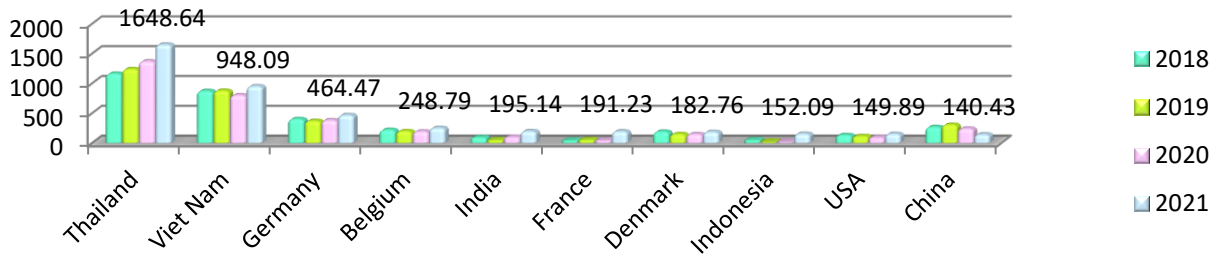
World's Top 10 exporter of Starches; Inulin (H.S Code-1108)

Rank	Countries	2018		2019		2020		2021	
		Value (million $)	Share (%)	Value (million$)	Share (%)	Value (million$)	Share (%)	Value (million$)	Share (%)
1.	Thailand	1158.95	26.45	1236.38	28.35	1366.43	31.30	1648.64	29.79
2.	Viet Nam	867.73	19.80	872.47	20.01	798.48	18.29	948.09	17.13
3.	Germany	397.10	9.06	365.97	8.39	378.75	8.68	464.47	8.39
4.	Belgium	216.65	4.94	194.47	4.46	189.95	4.35	248.79	4.50
5.	**India**	**91.94**	**2.10**	**49.33**	**1.13**	**98.03**	**2.25**	**195.14**	**3.53**
6.	France	43.81	1.00	52.05	1.19	46.03	1.05	191.23	3.46
7.	Denmark	185.61	4.24	144.86	3.32	144.53	3.31	182.76	3.30
8.	Indonesia	50.53	1.15	18.89	0.43	21.92	0.50	152.09	2.75
9.	USA	128.52	2.93	112.35	2.58	92.83	2.13	149.89	2.71
10.	China	264.01	6.02	302.32	6.93	239.35	5.48	140.43	2.54
	Others	977.46	22.30	1011.54	23.20	988.96	22.66	1211.97	21.90
	Total	4382.31		4360.64		4365.26		5533.50	

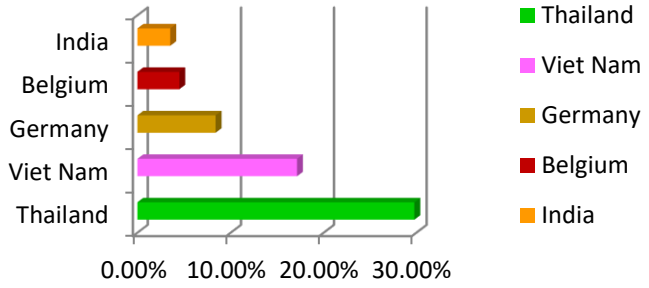
Source: UN Comtrade

World's top Exporters of Starches; Inulin from 2018-2021**(in million USD)**

Data label given on the basis of 2021



Country wise world's top 5 exporter of Starches; Inulin by percentage in 2021 :



In 2021, world export of Starches; Inulin was US $ 5.53 billion. In that year the global exports of Starches; Inulin increased from US $ 4.36 billion in 2020 to US $ 5.53 billion. Thailand was the largest exporter in the world of the said export structure, which was US $ 1.65 billion or accounted 29.79% of the global total in 2021, followed by Vietnam (17.13%) and Germany (8.39%). **India** stood at 5th position in ranking in the world leading exporting countries with 3.53% share of global export of Starches; Inulin in 2021.

Table-3

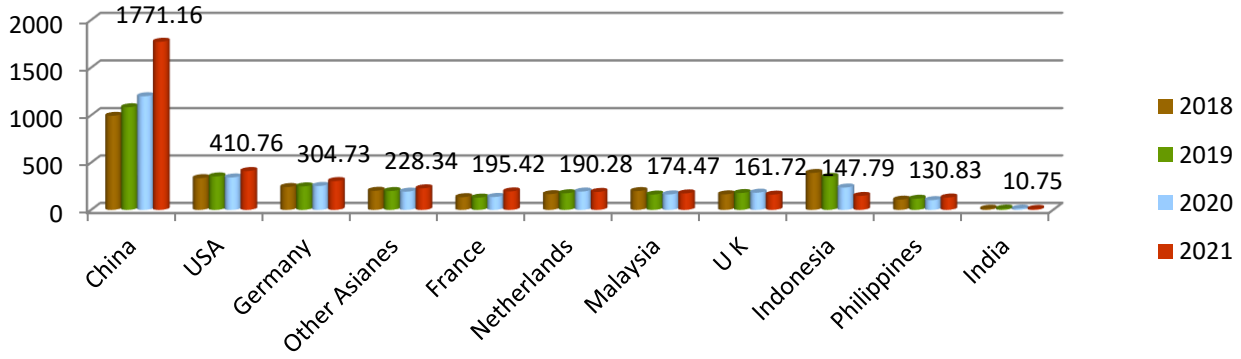
World's top 10 Importers of Starches; Inulin (H.S Code-1108)

Rank	Countries	2018		2019		2020		2021	
		Value (million $)	Share (%)	Value (million$)	Share (%)	Value (million$)	Share (%)	Value (million$)	Share (%)
1.	China	993.76	21.97	1083.67	23.38	1199.18	25.62	1771.16	31.27
2.	USA	335.34	7.41	353.71	7.63	342.79	7.32	410.76	7.25
3.	Germany	241.95	5.35	248.71	5.37	253.20	5.41	304.73	5.38
4.	Other Asianes	202.15	4.47	199.44	4.30	193.09	4.12	228.34	4.03
5.	France	134.59	2.98	129.80	2.80	136.92	2.93	195.42	3.45
6.	Netherlands	166.43	3.68	176.00	3.80	194.01	4.14	190.28	3.36
7.	Malaysia	199.10	4.40	162.35	3.50	163.74	3.50	174.47	3.08
8.	U K	164.63	3.64	178.35	3.85	181.86	3.89	161.72	2.85
9.	Indonesia	390.49	8.63	348.58	7.52	236.38	5.05	147.79	2.61
10.	Philippines	108.33	2.39	117.87	2.54	103.48	2.21	130.83	2.31
52.	**India**	**12.87**	**0.28**	**14.12**	**0.30**	**14.07**	**0.30**	**10.75**	**0.19**
	Others	1574.23	34.80	1621.95	35.00	1662.26	35.51	1938.48	34.22
	Total	4523.87		4634.54		4680.98		5664.74	

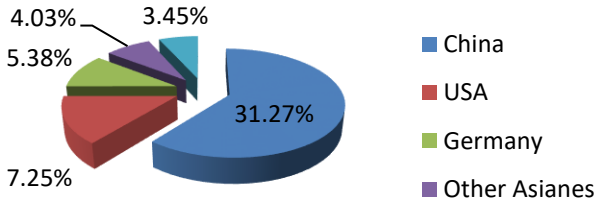
Source : UN Comtrade

Leading Starches; Inulin importers of world from 2018-2021**(in million USD)**

Data label given on the basis of 2021



Country wise world's top 3 importers of Starches; Inulin by percentage in 2021

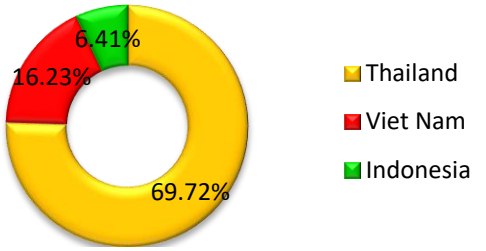


In 2021 with Starches imported by China with imports valued at approximately US $ 1.77 billion, accounted for 31.27 % of world import value of it . USA ranked in second that year, with a share of 7.25% of global import. Germany ranked in 3rd in the world in the same year, with 5.38% share globally. India ranked in 52nd position in the world with the share of only 0.19% of total Global import value of Starches :Inulin in that year.

Annre-1

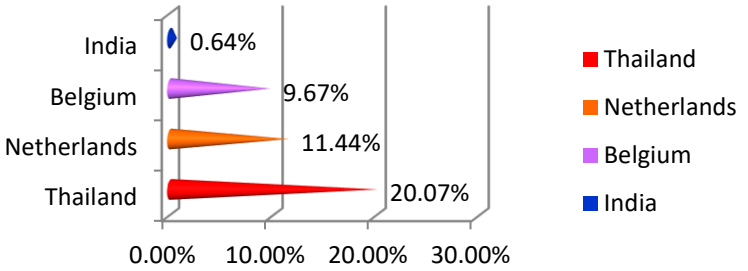
Sources of world's top 3 importers of Starches; Inulin (H.S Code-1108)

(i) Top 3 Sources of Starches :Inulin to China in 2021 by percentage:



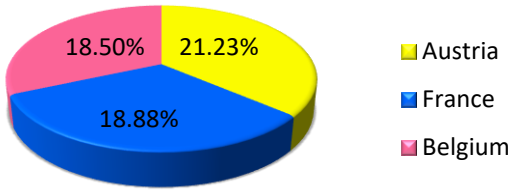
China imported most of its Starches :Inulin of from Thailand, 69.72% share of China's total import value of the commodity came from Thailand in 2021, 16.23% share came from Vietnam and 6.41% from Indonesia. **(Source : UN Comtrade)**

ii) Top 3 Sources of Starches :Inulin to USA in 2021 by percentage*:*



USA imports most of its requirements of Starches :Inulin from Thailand (20.07 %), Netherland (11.44%) ,from Belgium (9.67%) and from India's share was only 0.64% in 2020**.(.Source : UN Comtrade)**

iii) Top 3 Sources of Starches :Inulin to Germany in 2021 by percentage*:*



Austria was the largest source country of Starches to Germany. Austria has exported 21.23% of the Commodity group to Germany in 2021, It was followed by France (18.88%) and Belgium (18.50%). In that year **India** has exported only 12378 USD to Germany. **(Source: UN Comtrade)**

Organic Surface Active Agent (Other than soaps)

Surfactants are chemical compounds that decrease the surface tension between two liquids, between a gas and a liquid, or interfacial tension between a liquid and a solid. Surfactants may act as detergents, wetting agents, emulsifiers, foaming agents, or dispersants. The word "surfactant" is a blend of **surface-active agent..**

Agents that increase surface tension are "surface active" in the literal sense but are not called surfactants as their effect is opposite to the common meaning. A common example of surface tension increase is salting out: by adding an inorganic salt to an aqueous solution of a weakly polar substance, the substance will precipitate. The substance may itself be a surfactant – this is one of the reasons why many surfactants are ineffective in sea water.

Surfactants are usually organic compounds that are amphiphilic, meaning each molecule contains both a hydrophilic "water-seeking" group (the *head*), and a hydrophobic "water-avoiding" group (the *tail*). As a result, a surfactant contains both a water-soluble component and a water-insoluble component. Surfactants diffuse in water and get adsorbed at interfaces between air and water, or at the interface between oil and water in the case where water is mixed with oil. The water-insoluble hydrophobic group may extend out of the bulk water phase, into the air or into the oil phase, while the water-soluble head group remains in the water phase.

The hydrophobic tail may be either lipophilic ("oil-seeking") or lipophobic ("oil-avoiding") depending on its chemistry. Hydrocarbon groups are usually lipophilic, for use in soaps and detergents, while fluorocarbon groups are lipophobic, for use in repelling stains or reducing surface tension.

World production of surfactants is estimated at 15 million tons per year, of which about half are soaps. Other surfactants produced on a particularly large scale are linear alkylbenzene sulfonates (1.7 million tons/y), lignin sulfonates (600,000 tons/y), fatty alcohol ethoxylates (700,000 tons/y), and alkylphenol ethoxylates (500,000 tons/y).

The annual global production of surfactants was 13 million tons in 2008.[19] In 2014, the world market for surfactants reached a volume of more than US $33 billion. Market researchers expect annual revenues to increase by 2.5% per year to around $40.4 billion until 2022. The commercially most significant type of surfactants is currently the anionic surfactant LAS, which is widely used in cleaners and detergents.

Surfactants play an important role as cleaning, wetting, dispersing, emulsifying, foaming and anti-foaming agents in many practical applications and products, including detergents, fabric softeners, motor oils, emulsions, soaps, paints, adhesives, inks, anti-fogs, ski waxes, snowboard wax, deinking of recycled papers, in flotation, washing and enzymatic processes, and laxatives. Also agrochemical formulations such as herbicides (some), insecticides, biocides (sanitizers), and spermicides (nonoxynol-9). Personal care products such as cosmetics, shampoos, shower gel, hair conditioners, and toothpastes. Surfactants are used in firefighting and pipelines (liquid drag reducing agents). Alkali surfactant polymers are used to mobilize oil in oil wells.

Surfactants act to cause the displacement of air from the matrix of cotton pads and bandages so that medicinal solutions can be absorbed for application to various body areas. They also act to displace dirt and debris by the use of detergents in the washing of wounds and via the application of medicinal lotions and sprays to surface of skin and mucous membranes.

In solution, detergents help solubilize a variety of chemical species by dissociating aggregates and unfolding proteins. Popular surfactants in the biochemistry laboratory are sodium lauryl sulphate (SDS) and cetyl trimethylammonium bromide (CTAB). Detergents are key reagents to extract protein by lysis of the cells and tissues.

These are broadly classified under **H.S. Code-3402**

Table - 4

India's Top 10 destination of Organic Surface Active Agents ((HS Code –3402)

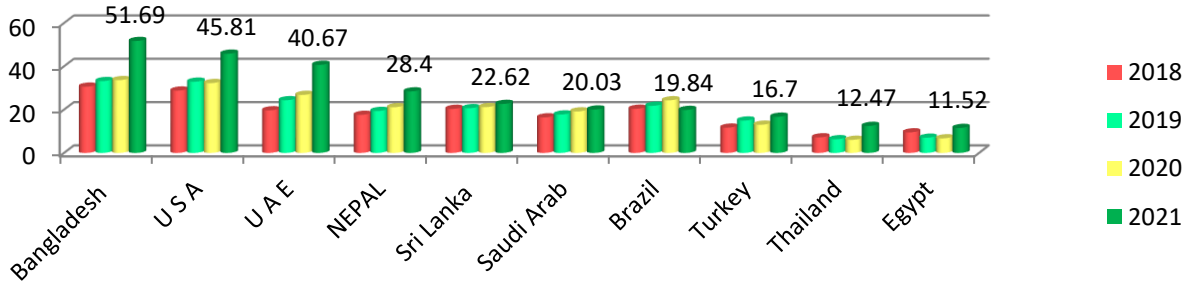
Rank	Countries	2018		2019		2020		2021	
		Value (million$)	Share (%)	Value (million$)	Share (%)	Value (million$)	Share (%)	Value (million$)	Share (%)
1.	Bangladesh	30.59	8.95	33.18	9.03	33.63	8.71	51.69	10.34
2.	U S A	28.79	8.43	32.89	8.95	32.26	8.36	45.81	9.17
3.	U A E	19.67	5.76	24.33	6.62	26.80	6.94	40.67	8.14
4.	NEPAL	17.58	5.15	19.37	5.27	21.11	5.47	28.40	5.68
5.	Sri Lanka	20.34	5.95	20.66	5.62	21.16	5.48	22.62	4.53
6.	Saudi Arab	16.40	4.80	17.73	4.83	19.16	4.96	20.03	4.01
7.	Brazil	20.39	5.97	21.76	5.92	24.30	6.29	19.84	3.97
8.	Turkey	11.67	3.42	14.94	4.07	13.02	3.37	16.70	3.34
9.	Thailand	7.18	2.10	6.31	1.72	6.04	1.57	12.47	2.50
10.	Egypt	9.49	2.78	7.02	1.91	6.72	1.74	11.52	2.31
	Others	159.53	46.70	169.30	46.07	181.85	47.11	229.92	46.01
	Total	341.63		367.49		386.05		499.69	

Source: DGCI&S

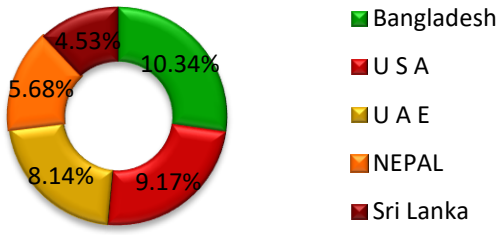
Note : India's Export including re-export

India's major destination Organic Surface Active Agents from 2018-2021**(Values in million USD)**

Data label given on the basis of 2021



India's top 5 destinations of Organic Surface Active Agents by percentage in 2021:



India's Surface Active Agents (Other than Soaps etc.) exports hit all-time high of US $ 499.69 million in 2021. The export of Surface Active Agents increased more than 29% in this year than the year 2020. Bangladesh, USA and UAE were the major importers of Surface Active Agents from India. Bangladesh has imported worth US $ 51.69 million in 2021, while USA and UAE has imported Surface Active Agents worth US $ 45.81 million and US $ 40.67 million respectively during the year. Other prominent importing countries were Nepal, Sri Lanka ,Saudi Arab etc.

Table - 5

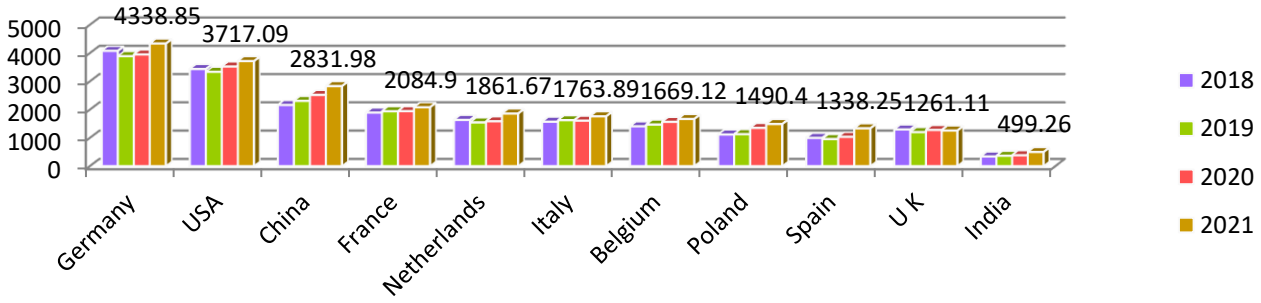
World's Top 10 exporters of Organic Surface Active Agents ((HS Code -3402)

Rank	Countries	2018		2019		2020		2021	
		Value (million$)	Share (%)	Value (million$)	Share (%)	Value (million$)	Share (%)	Value (million$)	Share (%)
1.	Germany	4080.04	13.18	3894.07	12.66	3952.24	12.15	4338.85	11.97
2.	USA	3437.22	11.10	3338.18	10.85	3526.40	10.84	3717.09	10.26
3.	China	2163.52	6.99	2309.38	7.51	2520.63	7.75	2831.98	7.81
4.	France	1895.60	6.12	1943.30	6.32	1945.30	5.98	2084.90	5.75
5.	Netherlands	1636.42	5.29	1547.66	5.03	1587.28	4.88	1861.67	5.14
6.	Italy	1572.60	5.08	1626.35	5.29	1609.53	4.95	1763.89	4.87
7.	Belgium	1408.52	4.55	1470.91	4.78	1566.75	4.82	1669.12	4.61
8.	Poland	1119.25	3.62	1131.86	3.68	1351.78	4.16	1490.40	4.11
9.	Spain	999.81	3.23	958.70	3.12	1036.25	3.19	1338.25	3.69
10.	U K	1297.86	4.19	1205.61	3.92	1279.08	3.93	1261.11	3.48
16.	**India**	**340.76**	**1.10**	**367.36**	**1.19**	**386.26**	**1.19**	**499.26**	**1.38**
	Others	11003.11	35.55	10966.00	35.65	11762.82	36.17	13387.00	36.94
	Total	30954.71		30759.37		32524.31		36243.52	

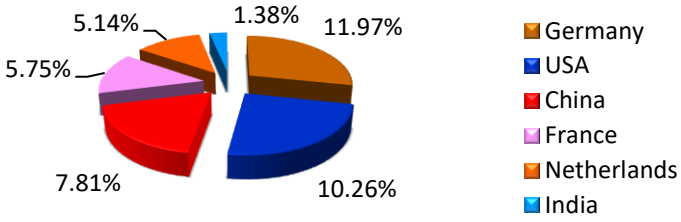
Source: UN Comtrade

Top world exporters of Organic Surface Active Agents from 2018 to 2021 **(Values in million USD)**

Data label given on the basis of 2021



Export trends in world's leading Organic Surface Active Agents exporters by percentage in 2021:



The Germany was the top exporting country by Surface Active Agents (Other than Soaps etc.) exports value in the world. As of 2021, Surface Active Agents (Other than Soaps etc.) exports worth value in the Germany was US $ 4.33 Billion accounts for 11.97% of the world's exports value. Other major exporting countries of Surface Active Agents (Other than Soaps etc.) in 2021 were USA and China. These major Three country's together exports accounted for more than 30% of it. India's position in world's export of Surface Active Agents (Other than Soaps etc.) was 16th rank in the world with 1.38% share.

Table - 6

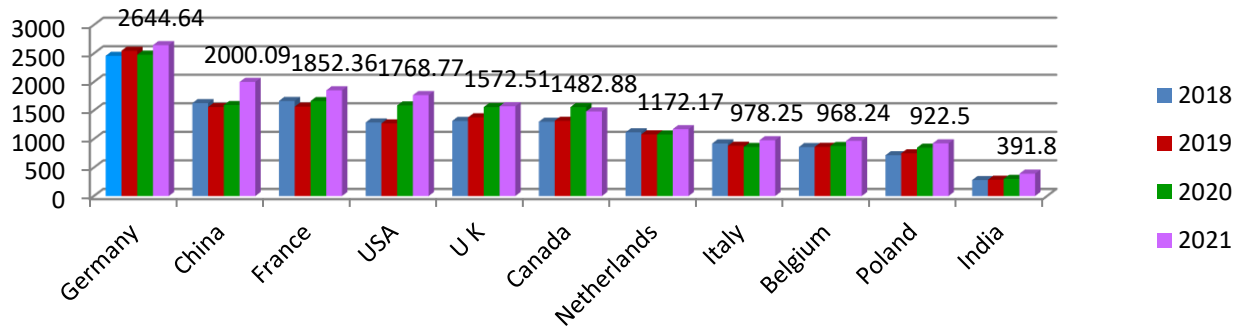
World's Top 10 Importers of Organic Surface Active Agents ((HS Code 3402)

Rank	Countries	2018		2019		2020		2021	
		Value (million $)	Share (%)	Value (million$)	Share (%)	Value (million$)	Share (%)	Value (million$)	Share (%)
1.	Germany	2457.55	8.06	2545.85	8.39	2477.07	7.71	2644.64	7.54
2.	China	1628.83	5.34	1559.46	5.14	1595.24	4.96	2000.09	5.70
3.	France	1665.96	5.47	1567.39	5.17	1662.93	5.17	1852.36	5.28
4.	USA	1288.73	4.23	1271.63	4.19	1588.40	4.94	1768.77	5.04
5.	U K	1316.62	4.32	1379.02	4.55	1558.82	4.85	1572.51	4.48
6.	Canada	1302.78	4.27	1319.17	4.35	1559.03	4.85	1482.88	4.23
7.	Netherlands	1116.91	3.66	1080.64	3.56	1078.51	3.36	1172.17	3.34
8.	Italy	922.14	3.03	881.14	2.90	859.32	2.67	978.25	2.79
9.	Belgium	857.68	2.81	861.31	2.84	877.41	2.73	968.24	2.76
10.	Poland	714.84	2.35	748.68	2.47	847.68	2.64	922.50	2.63
28.	**India**	**278.44**	**0.91**	**285.01**	**0.94**	**300.26**	**0.93**	**391.80**	**1.12**
	Others	16931.50	55.55	16838.31	55.50	17735.65	55.18	19320.31	55.08
	Total	30481.98		30337.61		32140.32		35074.53	

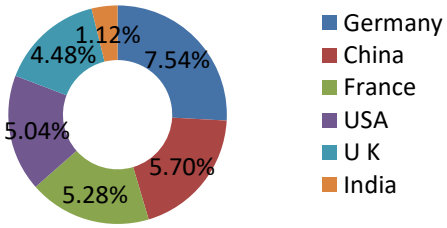
Source :UNComtrade

Top world importers of Organic Surface Active Agents from 2018 to 2021 **(Values in million USD)**

Data label given on the basis of 2021



Country wise leading global Importer of Organic Surface Active Agents by percentage in 2021

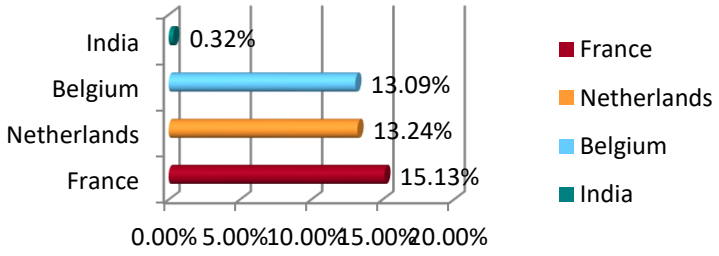


Of Surface Active Agents (Other than Soaps etc.) importers, Germany was the largest Surface Active Agents (Other than Soaps etc.) -importing nation. Its import worth value of was US $ 2.64 billion in 2021, accounted 7.54% share of world import value of Surface Active Agents (Other than Soaps etc.) . The China, France, USA and UK also import large values of Surface Active Agents (Other than Soaps etc.) . Collectively, these five major countries represent more than 28% of globally imported Surface Active Agents (Other than Soaps etc.) during 2021. In the same year India imported 1.12% share of of the commodity and stood at 28th position in ranking in the world.

Annexure-II

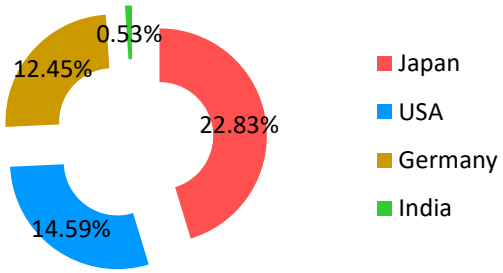
Sources of world's top three importers of Organic Surface Active Agents

(i) Top 3 Sources of Organic Surface Active Agents to Germany in 202 by percentage*:*



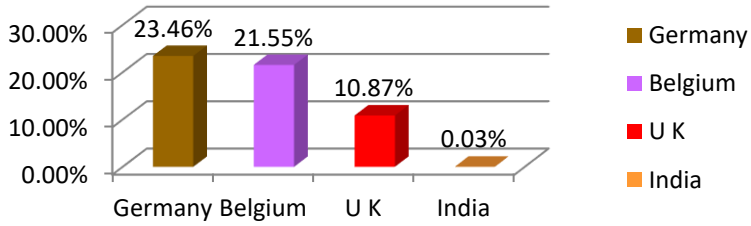
France is the main source of Organic Surface Active Agents to Germany, France exported 15.13 % share of Germany's total import of the commodity in 2021. Belgium and Netherlands are found to be the 2nd and 3rd largest exporters of Organic Surface Active Agents to Germany by 13.24% and 13.09% shares of Germany's total import respectively in 2021. Apparently Germany imported only 0.32% share of its total import of the commodity from India in 2021. **(Source: UN Comtrade)**

(ii) Top 3 Sources of Organic Surface Active Agents to China in 2021 by percentage**:**



22.83% share of Organic Surface Active Agents imports to China came from Japan in 2021, it was followed by USA (14.59%) and Germany (12.45%). India's share only 0.53% **(Source: UN Comtrade)**

(iii) Top 3 Sources of Organic Surface Active Agents to France in 2021 by percentage**:**



With 23.46% share of France's total import of Organic Surface Active Agents, Germany became the largest source of it to France in 2021. Belgium (21.55 %) and UK (10.87%) were other major sources of Organic Surface Active Agents to France in that year. India's share was only 0.03% of Mexico's total import in 2021. **(Source : UN Comtrade)**

IMPORT

Copper Fittings

Copper pipe fittings play an important role in many plumbing and heating applications. These fittings are used for installation of various types of pipes. In fact, copper pipe fittings are mainly used with copper pipes used for supplying hot and cold water in residential water supply lines, as refrigerant line in HVAC, etc. Copper pipe fittings are available in many different sizes and styles and you can select the right one for your application.

Copper pipe fittings are extremely resistant to corrosion, and hence are mostly preferred for household water supply pipelines and other plumbing operations.

The pipe fittings also vary depending on the type of pipe used. Copper pipes and fittings are usually made of two basic types of copper:

Soft copper: Tubes or pipes made of soft or ductile copper can be easily bent to travel around obstacles in the path of the tubing. Soft copper tubing is the only type, which is suitable for flare connections. Soft copper mostly preferred for refrigerant lines in split-system air conditioners and heat pumps.

Rigid copper: Rigid copper is widely popular for water pipelines. Rigid copper pipes are connected using compression or sweat connection. As the name suggests, rigid copper cannot be bent and must use elbow fittings to go around corners or avoid obstacles.

In the North American plumbing industry, the size of copper tubing is designated by its nominal diameter, which is 1⁄8th inch less than the outside diameter. The inside diameter varies according to the thickness of the pipe wall, which differs according to pipe size, material, and grade: the inside diameter is equal to the outside diameter, less twice the wall thickness.

The North American refrigeration industry uses copper pipe designated **ACR** (air conditioning and refrigeration field services) pipe and tubing, which is sized directly by its outside diameter (OD) and a typed letter indicating wall thickness. Therefore, one-inch nominal type L copper tube and 1+1⁄8th inch type D ACR tube are exactly the same size, with different size designations. ACR pipe is manufactured without processing oils that would be incompatible with the oils used to lubricate the compressors in the air conditioning system.

Except for this difference between ACR (types A and D) and plumbing (types K, L, M, and DWV) pipes, the type only indicates wall thickness and does not affect the outside diameter of the tube. Type K 1⁄2 inch, type L 1⁄2 inch, and type D 5⁄8 inch ACR all have the same outside diameter of 5⁄8 inch. In both the U.S. and Canada, copper pipe and fittings are sold in imperial units only as metric sizes are not manufactured for use in North America.[5] Many Canadian merchants give approximate metric sizes for construction products, but in the case of copper pipes and fittings, these approximations are not interchangeable with metric components

Generally, copper tubes are soldered directly into copper or brass fittings, although compression, crimp, or flare fittings are also used. Formerly, concerns with copper supply tubes included the lead used in the solder at joints (50% tin and 50% lead). Some studies have shown significant leaching of the lead into the potable water stream, particularly after long periods of low usage, followed by peak demand periods. In hard water applications, shortly after installation, the interior of the pipes will be coated with the deposited minerals that had been dissolved in the water, and therefore the vast majority of exposed lead is prevented from entering the potable water. Building codes throughout the U.S. require the use of virtually "lead-free" (<0.2% lead) solder or filler metals in plumbing fittings and appliances.

These are broadly classified under **H. S. Code 7412**.

Table - 7

India's Top 10 Sources of Copper Fittings (HS Code :7412)

Rank	Countries	2018		2019		2020		2021	
		Value (million $)	Share (%)	Value (million$)	Share (%)	Value (million$)	Share (%)	Value (million$)	Share (%)
1.	Japan	15.57	18.68	15.02	21.50	10.77	19.31	21.32	26.85
2.	Korea RP	13.81	16.58	13.66	19.54	9.99	17.91	14.87	18.73
3.	Denmark	10.64	12.77	9.23	13.21	10.22	18.33	13.62	17.15
4.	China	16.48	19.77	11.84	16.94	7.96	14.27	11.19	14.09
5.	Germany	2.45	2.94	2.57	3.68	2.39	4.29	3.78	4.77
6.	Malaysia	5.46	6.55	5.05	7.22	3.18	5.70	2.73	3.44
7.	Sweden	1.43	1.71	0.79	1.13	1.26	2.25	2.59	3.26
8.	Singapore	2.18	2.62	2.07	2.96	2.14	3.83	2.29	2.88
9.	France	2.44	2.93	1.62	2.31	1.25	2.25	1.18	1.49
10.	Italy	0.77	0.92	0.63	0.90	1.07	1.91	1.15	1.45
	Others	12.12	14.54	7.42	10.61	5.56	9.97	4.69	5.90
	Total	83.34		69.88		55.77		79.41	

Source: DGCI&S

Note : India's Import including re-import

There was a total of 51 countries India imports Copper Fittings. The Sewing Copper Fittings import of India in 2021 stood at US $ 79.41 Million which was almost 2.54 more from the year 2020. Major three source countries of Copper Fittings to India in 2021 were Japan (US $ 21.32 Million), Korea Rep. (US $14.87 Million) and Denmark (US $ 13.62 Million). These 3 countries in total sold US $ 49.81 Million value of Copper Fittings to India which rounds up to 62.73% of world import in 2021.

Table - 8

World Top 10 Importer of Copper Fittings (HS Code :7412)

Rank	Countries	2018		2019		2020		2021	
		Value (million $)	Share (%)	Value (million$)	Share (%)	Value (million$)	Share (%)	Value (million$)	Share (%)
1.	USA	750.70	14.68	772.26	15.46	660.74	13.95	941.28	14.36
2.	Germany	506.58	9.90	474.95	9.51	464.43	9.80	627.96	9.58
3.	France	263.68	5.16	268.16	5.37	250.55	5.29	362.54	5.53
4.	Poland	225.85	4.42	222.55	4.46	236.92	5.00	361.30	5.51
5.	U K	228.85	4.47	242.98	4.86	175.38	3.70	255.61	3.90
6.	Mexico	224.58	4.39	207.31	4.15	168.99	3.57	250.28	3.82
7.	Russia	174.69	3.42	161.75	3.24	163.73	3.46	234.18	3.57
8.	Netherlands	145.79	2.85	150.12	3.01	146.99	3.10	207.02	3.16
9.	Japan	184.48	3.61	172.48	3.45	144.81	3.06	201.13	3.07
10.	Austria	114.73	2.24	114.99	2.30	137.56	2.90	197.08	3.01
44.	**India**	**19.33**	**0.38**	**19.60**	**0.39**	**21.55**	**0.45**	**26.54**	**0.40**
	Others	2275.31	44.49	2188.02	43.80	2166.42	45.72	2890.66	44.09
	Total	**5114.57**		**4995.16**		**4738.07**		**6555.57**	

Source :UNComtrade

Global Imports of Copper tube fittings, the top five importers in 2021 were USA (US $ 941.28M), Germany (US $ 627.96 M), France (US $ 362.54 M), Poland (US $ 361.30 M) and UK (US $ 255.61 M), respectively of world import value of Copper tube fittings. The import value of Copper tube fittings into **India** amounted to US $ 26.54 million in the year 2021 and ranked in 44th position in the world with the share of 0.40% of total Global import value of Copper tube fittings. The world import of Copper tube fittings rose by 38.34% in 2021 compare to that in the year 2021.

Quaternary ammonium Salts and Hydroxide

Quaternary Ammonium Salts, also known as quats, are positively charged polyatomic ions of the structure NR+4, R being an alkyl group or an aryl group. Unlike the ammonium ion (NH+4) and the primary, secondary, or tertiary ammonium cations, the quaternary ammonium cations are permanently charged, independent of the pH of their solution. Quaternary ammonium salts or quaternary ammonium compounds (called quaternary amines in oilfield parlance) are salts of quaternary ammonium cations. Polyquats are a variety of engineered polymer forms which provide multiple quat molecules within a larger molecule.

Quats are used in consumer applications including as antimicrobials (such as detergents and disinfectants), fabric softeners, and hair conditioners. As an antimicrobial, they are able to inactivate enveloped viruses (such as SARS-CoV-2). Quats tend to be gentler on surfaces than bleach-based disinfectants, and are generally fabric-safe.

Quaternary ammonium compounds are prepared by the alkylation of tertiary amines with a halocarbon. In older literature this is often called a Menshutkin reaction, however modern chemists usually refer to it simply as **quaternization**. The reaction can be used to produce a compound with unequal alkyl chain lengths; for example when making cationic surfactants one of the alkyl groups on the amine is typically longer than the others.

. Quaternary ammonium cations are unreactive toward even strong electrophiles, oxidants, and acids. They also are stable toward most nucleophiles. The latter is indicated by the stability of the hydroxide salts such as tetramethylammonium hydroxide and tetrabutylammonium hydroxide even at elevated temperatures. The halflife of Me_4NOH in 6M NaOH at 160 °C is >61 h.

Because of their resilience, many unusual anions have been isolated as the quaternary ammonium salts. Examples include tetramethylammonium pentafluoroxenate, containing the highly reactive pentafluoroxenate (XeF^-_5) ion. Permanganate can be solubilized in organic solvents, when deployed as its NBu^+_4 salt.

With exceptionally strong bases, quat cations degrade. They undergo Sommelet–Hauser rearrangement[10] and Stevens rearrangement, as well as dealkylation under harsh conditions or in presence of strong nucleophiles, like thiolates. Quaternary ammonium cations containing N−C−C−H units can also undergo the Hofmann elimination and Emde degradation.

Quaternary ammonium salts are used as disinfectants, surfactants, fabric softeners, and as antistatic agents (e.g. in shampoos). In liquid fabric softeners, the chloride salts are often used. In dryer anticling strips, the sulfate salts are often used. Older aluminium electrolytic capacitors and spermicidal jellies also contain quaternary ammonium salts. Quats are also used in contraception formulations, veterinary products, diagnostic testing, vaccine production, and nasal formulations.

Quaternary ammonium compounds have antimicrobial activity. Quaternary ammonium compounds, especially those containing long alkyl chains, are used as antimicrobials and disinfectants. Examples are benzalkonium chloride, benzethonium chloride, methylbenzethonium chloride, cetalkonium chloride, cetylpyridinium chloride, cetrimonium, cetrimide, dofanium chloride, tetraethylammonium bromide, didecyldimethylammonium chloride and domiphen bromide. Also good against fungi, amoebas, and enveloped viruses (such as SARS-CoV-2), quaternary ammonium compounds are believed to act by disrupting the cell membrane or viral envelope. Quaternary ammonium compounds are lethal to a wide variety of organisms except endospores and non-enveloped viruses..

Quaternary ammonium compounds can display a range of health effects, amongst which are mild skin and respiratory irritation up to severe caustic burns on skin and the gastrointestinal wall (depending on concentration), gastrointestinal symptoms (e.g., nausea and vomiting), coma, convulsions, hypotension and death.

These are broadly classified under **H. S. Code 2923**.

Table - 9

India's Top 10 Source Countries of Quaternary Ammonium Salts and Hydroxide (HS Code : 2923)

Rank	Countries	2018		2019		2020		2021	
		Value (million $)	Share (%)	Value (million$)	Share (%)	Value (million$)	Share (%)	Value (million$)	Share (%)
1.	China	12.01	21.73	13.60	26.40	14.09	22.83	21.82	27.15
2.	Argentina	9.45	17.10	5.03	9.75	11.93	19.32	18.78	23.37
3.	Germany	7.11	12.86	7.92	15.37	6.84	11.08	11.22	13.96
4.	Bangladesh	1.99	3.60	2.05	3.97	3.56	5.77	6.17	7.67
5.	U S A	7.12	12.88	4.33	8.41	5.06	8.20	5.39	6.71
6.	Ukraine	2.56	4.64	3.08	5.98	4.47	7.24	2.74	3.41
7.	Switzerland	0.58	1.05	1.42	2.75	2.37	3.84	2.65	3.29
8.	Korea RP	1.09	1.97	1.19	2.30	0.71	1.16	2.06	2.56
9.	Netherland	2.49	4.50	1.84	3.57	1.07	1.73	1.53	1.91
10.	Russia	0.26	0.48	0.10	0.20	0.65	1.05	1.29	1.61
	Others	10.60	19.19	10.98	21.30	10.98	17.78	6.71	8.36
	Total	55.26		51.53		61.72		80.36	

Source: DGCI&S

Note : India's Import including Re-import

The value of imports of Quaternary Ammonium Salts and Hydroxide to India totalled US$ 80.36 million in 2021. Sales of Quaternary Ammonium Salts and Hydroxide to India increased by more than 30% in value terms compared to 2020. Major five source countries of Activated Carbons to India in 2021 were China(US $ 21.82 Million), Argentina (US $ 18.78 Million), Germany (US $ 11.22 Million), Bangladesh (US $ 6.17 Million) and USA (US $5.39 Million). These 5 countries in total exported US $ 63.38 Million value of Quaternary Ammonium Salts and Hydroxide to India which rounds up to 78.86% of the total Quaternary Ammonium Salts and Hydroxide import into India.

Table - 10

World Top 10 Importer of Quaternary Ammonium Salts and Hydroxide (HS Code : 2923)

Rank	Countries	2018		2019		2020		2021	
		Value (million$)	Share (%)	Value (million$)	Share (%)	Value (million$)	Share (%)	Value (million$)	Share (%)
1.	USA	247.60	9.64	245.08	10.14	219.68	9.10	252.94	8.78
2.	Rep. of Korea	220.18	8.57	227.57	9.42	194.73	8.07	242.53	8.42
3.	Netherlands	205.66	8.01	171.27	7.09	175.67	7.28	225.37	7.83
4.	Germany	174.10	6.78	173.96	7.20	184.19	7.63	202.87	7.04
5.	France	106.71	4.16	97.35	4.03	99.98	4.14	156.37	5.43
6.	China	99.72	3.88	100.37	4.15	99.01	4.10	127.17	4.42
7.	Japan	97.87	3.81	97.14	4.02	85.42	3.54	107.10	3.72
8.	Italy	89.31	3.48	77.48	3.21	74.81	3.10	83.00	2.88
9.	India	55.32	2.15	51.61	2.14	62.06	2.57	80.84	2.81
10.	Spain	57.88	2.25	55.80	2.31	71.23	2.95	75.51	2.62
	Others	1213.53	47.26	1118.42	46.29	1147.16	47.52	1325.98	46.05
	Total	**2567.87**		**2416.07**		**2413.95**		**2879.67**	

Source :UNComtrade

The three major importers of Quaternary Ammonium Salts and Hydroxide, namely USA, Rep. of Korea and Netherlands represented more than 25% of total global imports in 2021. In value terms, USA (US $ 252.94 M), Rep. of Korea (US $ 242.53M) and Netherlands (US $ 225.37 M) constituted the countries with the highest levels of imports in 2021. **India** experienced the highest growth rate of the value of imports, among the main importing countries and ranked in 9th position in the world with 2.81% share of Global import of Quaternary Ammonium Salts and Hydroxide in 2021.