Industrial Inorganic Chemistry
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Lecture – 01
Introduction

Hello, welcome to this class of Industrial Inorganic Chemistry, where we will be talking about some aspects of inorganic chemistry initially. And then we will try to correlate those inorganic principles, practices, theory to the industry level. Where we can see that how we can utilize the concepts, the principles and the practices of the typical inorganic chemistry what we learn in our classroom to the industry level. Where the industrial things can be operated nicely such that we can develop based on the inorganic chemicals to different industrial aspects such as what we see that in case of the typical inorganic chemistry.

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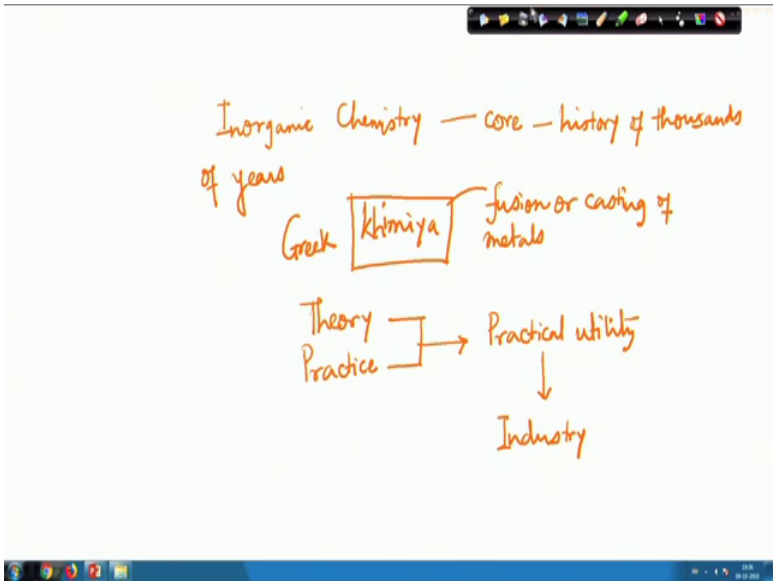

What we know that, we know that inorganic chemistry which is traditionally very interesting aspects of chemistry and which deals with the core of typical chemistry, because it has a history of thousands of years, because we all know that a term khimiya is typically in Greek language is known as that form; what we today use as chemistry, but originally then the Greek nomenclature, it is known as fusion. So, we should all know what is fusion or casting of metals.

So, what we see that if we consider that certain metals are there, and if we consider those fusion reaction or the casting between those metals which originally the Greek people were termed as the khimiya and from that we developed that particular branch of thing, branch of science which is known as chemistry. And one part of that is known as your inorganic chemistry, which will be dealing with both theory and the practice.

So, this is very important that the theoretical principles and the practice for that is also related for the development of this particular subject for practical utility. So, this practical utility will be covered in the industry part, when we can use that for our industrial purpose. So, what are those things basically, we can talk in terms of these particular things that how we can use the industrial part for this inorganic chemistry that we will see that in case of handling these as from the different sources.

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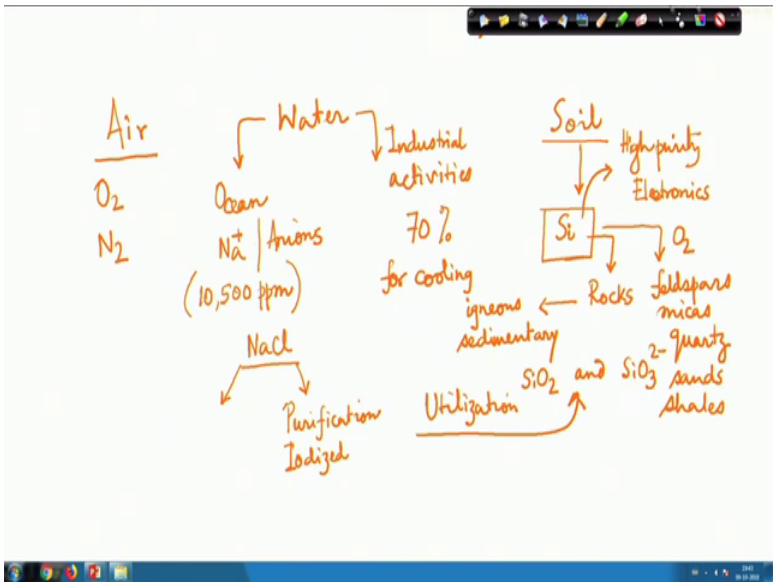

Like that of air we all know, and water, and soil. So, these are the constituents if we just consider. So, what are the corresponding components we can derive in terms of air inorganic chemistry from these we will see. So, as we all know that air can give us oxygen, it can give us nitrogen, and many other gaseous products. So, how we can utilize this oxygen or this nitrogen for some meaningful compound preparation?

Similarly, in case of water we know that there is a vast, majority of chemicals present in ocean. So, in ocean one such important thing is our sodium ion, the sodium plus. And the presence of sodium in ocean is in the range of say 10500 ppm or we considered that that

much milligram per kg. So, this amount of sodium is available for us. So, this water we can use for the extraction of sodium and obviously, the other anionic parts.

So, other anions will also be there as a part. So, if we consider that water as our source material or the bulk material for industrial production of some sodium salt, simple salt is we all know from our childhood that it is sodium chloride. So, the making of sodium chloride not only making or the industrial production of sodium chloride and also the purification.

And nowadays we know that not only purification, but we go for the iodized salts. So, it is iodized; so, the preparation of sodium chloride which is the material which we get from water only. And their concentration, their crystallization, and then addition of iodide and iodine is in the final form. So, the industry people who are interested to make the edible sodium chloride or the table salt to us, they will be interested to know all these things related to the source material; that means, our ocean water.

And also this particular water is useful for different industrial activities. So, those are our industrial activities. And those industrial activities basically use a huge amount of water, say is known that the 70 percent of water is utilized for the cooling purpose; so, not only the utilization of water, but also its corresponding removal from the industry. So, when we use water, 70 percent of the used water is utilized for cooling purposes only. So, it is basically increasing the temperature of the water, what we are discharging in ocean, river or pond. So, the thermal behaviour of that particular water is changing. So, we will also change the corresponding aquatic environment of the water, which is present in ocean, which is present in sea and which is present in pond.

So, not only these things so that some environmental aspects also we should be able to consider when we know, only consider the corresponding use of water for the industrial purpose. Then another important area is your soil, soil we all know that how we can utilize soil also, because the composition of soils should be known to us. And we all know that the main constituent of soil is our silicon. So, this particular silicon if we are able to get it from soil, but it is not always possible, but it is all sometime it is possible to get a very high purity silicon.

Silicon vapour, we all know now. So, high purity silicon will be utilized for electronics engineering or electronics industry. So, for electronics industry, we required that silicon

and that silicon is the major constituent for our soil, because we know that this silicon is utilized for the rock formation that means, rocks are utilized for that. What are the different rocks in terms of our geological knowledge or geophysical knowledge that these are igneous or sedimentary rocks. So, these sedimentary rocks can have simply Si O 2 the silica or the silicates Si O 3 2 minus. So, these silica or the silicates are the main constituents, when we utilize these with this silicon with O 2.

So, the utilization of O 2 is important such that we get from silicon to silicon dioxide to silicates the silicate anions, because the natural source of this silica is found in feldspars, in micas, in quartz, in sands which is nothing but your silicon dioxide. But, is not of high purity, because iron and many other constituent is present, because to get a high purity silica is also a challenging task from its industrial aspects as well as application. Then it is also available from different shales.

So, where we can use the utilization? The utilization for those will be therefore, very much important. So, how we use this as this one for our utilization is that application.

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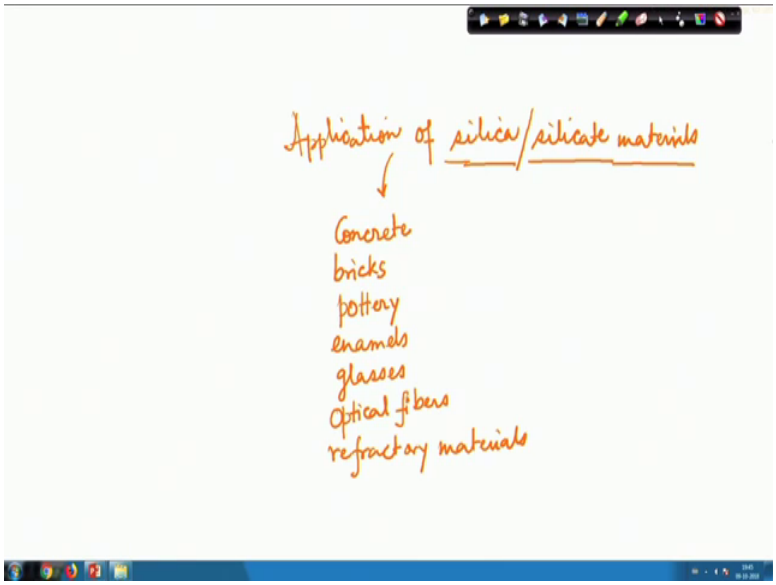

Utilization is nothing but our application of silica or silicate materials; so that gives us also some very interesting idea that not only the element form. Silica is the elemental form the silica Si, but also the naturally occurring what we obtain from the earth crust or the soil is the silicates. So, they can be utilized for our concrete formation along with

cement, the port land cement or any other thing, because we add we all know that we add sand to the concrete mixtures.

So, for formation of the concrete, then the formation of bricks. So, the brick industry is also be utilized and where the basic constituent in terms of our silica that means, inorganic aspect of silica as well as silicates; is there still present with bricks. Then we can have the pottery material, then we can have the enamels, then glasses. And most important thing, what we can make from our silica like high purity silica as we have seen for making that optical fibres and the different refractory materials.

So, these are important things that what all these industrial aspects related to only silica. So, observation of all these things element wise; so if we go through the entire periodic table, what we will see that element wise we can classify, all these applications and all these importance.

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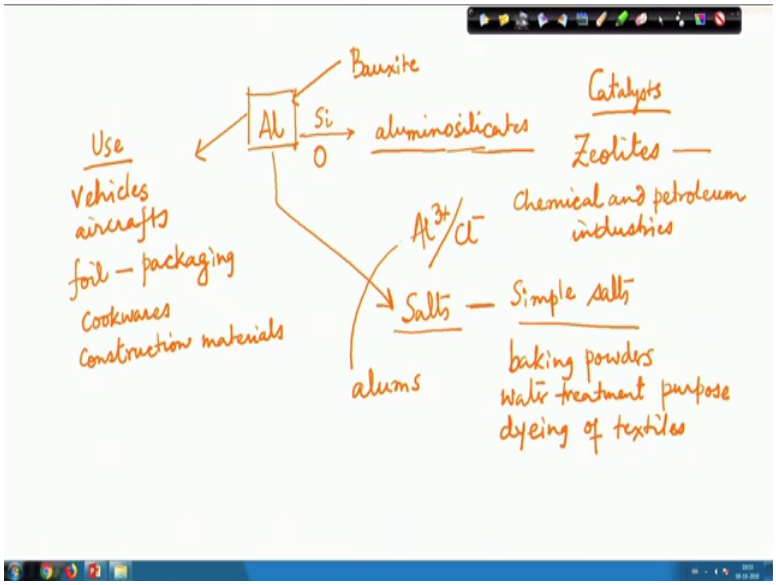

Particularly for this introductory class, what we can see that along with silica now if we can go for another important element, which is nothing but our aluminium. So, how aluminium and it is related industry can be useful, when we can have the combination of these along with some silicon as well as oxygen, because we have seen that how we can utilize that oxygen from water that will also see.

So, the typical use of aluminium as metallic aluminium, because most of the things will cover not in terms of the material, but we also consider in terms of the metals. So, metallurgy will also come into play for this Industrial Inorganic Chemistry, but initially when we consider the pure elemental for or the pure metallic form; we should always consider it as its use. So, the formation of this material for different vehicles, the car body to aeroplane bodies, such as aircrafts.

So, we can have vehicles, we can have aircrafts, then the fine aluminium foil, can also we all know from our day to day use that foils can also be used for packaging industry, for packaging purpose. So, very high quality aluminium, because the food quality aluminium should be there. Then we know that the aluminium utensils that means, the cook wares we can have and the construction material; because the aluminium seats, aluminium rods and all these are very useful for constructing building and for roof material, and all these. So, this can be our very good construction material. So, these are the construction materials.

So, so at one end when we talk in terms of the aluminium, and the other end we should have something, where we get the bulk material that how this aluminium can be obtained from the ores and the minerals that immediately gives us the idea about how we use the bauxite, which is nothing but our Al 2 0 3 aluminium oxide. So, getting pure quality aluminium from bauxite is also a challenging task.

So, the industry people are also involved for making high quality aluminium; if we get aluminium by electrolysis, so that we will also be covered in this particular course that electrolysis of this bauxite in the molten cryolite. We can use what is cryolite, what is bauxite that we will see, when we talk in terms of the corresponding availability of aluminium from the mineral or the ore.

So, along with these the two other things what we are so far considering that means, the silicon dioxide that means, if we put element wise silicon and oxygen to that we get something as, we get this as alumino silicates. So, what are those materials? So, how we get those alumino silicates because, these most of these are naturally occurring. So, these alumino silicates are also very important thing and very interesting things, where we have aluminium, alumino.

Then just now we have discussed in our previous slide that what is silica. So, we have silica and in presence of oxygen we can have the silicates. So, is the different variety of silicates, where aluminium is also present. So, aluminium is forming bonds with oxygen. Similarly, silicon is also forming bonds with oxygen giving us alumino silicates, but the most important application of this type of material is for catalysts.

So, industrial application of these will be there. Enormous application for these will be in terms of the corresponding catalyst, and those catalysts will also be useful for getting different types of zeolites. So, how these zeolites so, zeolites will be useful for very important industrial conversions for different chemical industry as well as petroleum industries, industries these will be useful. So, once we handle zeolite as the catalyst, we should always remember that we are handling something which is nothing but alumino silicate, because it saves that different structures at different ports will be there, whether will be utilizing it as a heterogeneous catalysts or not that we will see.

So, this is one aspect. So, one more aspect for this aluminium industrial chemistry or the inorganic chemistry of aluminium, how we can apply that inorganic chemistry of aluminium to industrial aspect is that of our different salts. So, like alumino silicate, because some of these are the catalysts or the zeolite they are insoluble in water; because when we talk in terms of that simple aluminium salts that means, they are the first and foremost thing for these as in terms of the definition that means, what is the aluminium salts or salts of aluminium ions and what are these catalysts which are insoluble in water.

So, these will be the simple sorts of aluminium ions, which is aluminium we all know which is aluminium 3 plus. The most common oxidation state of aluminium is not allow aluminium 1 plus, aluminium 1 plus, but aluminium 3 plus; it has tremendous industrial application for this particular cation only. So, what are those simple salts, we can have.

So, these simple salts that means, aluminium as the cation. So, we can use the anions. So, aluminium trichloride very simple salts and from our school level knowledge we know that the aluminium trichloride is a very useful material for not only for inorganic purpose, but also for organic transformations. So, this is useful for some useful purposes. So, one such is for getting baking powders.

Then can be utilized in terms of that aluminium based alarms we can have. So, these alarms are also useful for water treatment. The potassium aluminium sulphate we all know; the fate carry we all know for water treatment purpose.

Then this aluminium, some simple aluminium sulphate can be utilized for dyeing of textile materials or textiles. So, these are the most important aspects or the application of our same water or the water we get from ponds or rivers. We are having some plenty of sodium ions and the sodium chloride as a common table salt, we can utilize for our regular consumption.

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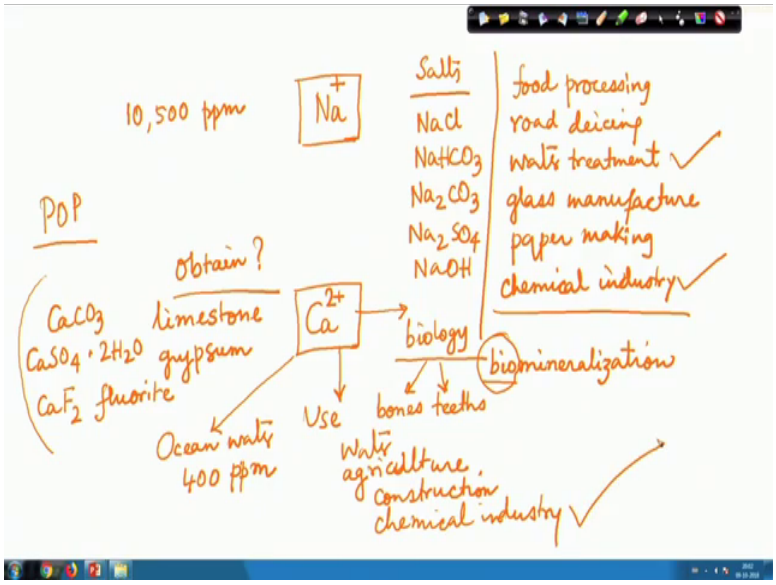

So, when we get this sodium that means, the sodium ion in seawater. We have seen that it is available in the range of 10500 ppm; so that amount is very useful one for the isolation of sodium chloride. So, useful compounds or useful salts basically so that there will be some industry and those industry will be dealing with all these or making of these sodium salts very useful way.

So, one such is the simple table salts. So, there are large industries, in our country also. They are making huge amount of all these things, because the huge consumption of sodium chloride is in the air; whereas, the food material or as a preservative in our day to day use. Then we all know: what is our bicarb, commonly we call as bicarb which is sodium bicarbonate. So, the source remains the same that we can have sodium ion from

seawater or the ocean water or the pond water. Then washing soda is sodium carbonate, then sodium sulphate we can have Na 2 So 4 and the caustic soda the NaOh.

So, what are the important areas, where we can use these common salts, if a particular industry is devoted of making or isolating sodium ions from seawater. We can utilize these for not only making sodium chloride, but also up to sodium hydroxide preparation we can use, but for what purpose the first and foremost important for making food material or for different food processing or as preservative.

So, for food processing we can utilize some of these salts the sodium bicarbonate or sodium chloride. Then sometime it can use for road dicing, then again water treatment to get it is required salinity; so water treatment. Then for glass manufacture, then for papermaking and all other different chemical industry, we can utilize this. So, likewise if we just go for calcium which is a dye positive one, in its ionic form. So, these are the typical ions we know.

And where from we get, we can obtain from where the common sources like that of our sodium we should know that also, because these are the raw material or the bulk material. What we can utilize for getting calcium or the calcium important calcium salt. So, one such is the typical limestone, we all know what is limestone. So, limestone is there which is nothing but calcium carbonate.

Then gypsum which is the corresponding sulphate salt, with 2 water of hydration. And we all know that from gypsum, we make Plaster of Paris; where the nature of this hydration or the hydration water of hydration is different for that Plaster of Paris, but it has some other typical property for hardening and all other thing as a good material. We know the Plaster of Paris, the Plaster of Paris we all know that for our wall plastering.

After cement work, we use POP the Plaster of Paris coating for the different types of walls. So, how we get the Plaster of Paris from gypsum is also interesting knowledge to be obtained for knowing the industrial importance of the inorganic chemistry. Then the corresponding fluorite salt, which is calcium fluoride. So, this fluorite this particular fluorite salt is therefore, very important in a way that this can give us the corresponding fluorinating agent or calcium fluoride as a different salt or different material for making other types of compounds.

So, as for this particular source of gypsum, limestone and fluorite; this can also like that of our sodium ion can also be obtained from ocean water or seawater, but at lower amount compared to our sodium, which is only obtained at 400 ppm. So, this much calcium if we can get from seawater that can be used for this particular material, because it has tremendous application.

Starting from our medical application, because we all know that our bones, the teethes and the very hard materials. So, the biologically it is also important. So, we will not have enough time to discuss the biological part and all these things, but we should know the importance of calcium; in terms of these materials from its industrial aspect and as well as some material, because the synthetic material, the synthetic bones and teethes will be having making all these things.

So, the biological thing for getting calcium into this hard material is nothing but is our bio mineralization, but we all know that the typical mineralization process that calcium mineralization process is responsible for the ore and mineral formation like gypsum formation or limestone formation. Similarly, in our biological ward in our body as well as the bodies of the different animals, we get that the corresponding mineralization process, but in a typical biological environment within biological tissues and all other living part. So, this biological mineralization process we give us the bones and teethes.

Then finally, we can use its different use that means, like that of our water treatment, what we have seen in case of sodium case. So, this also we can use for water treatment. So, water treatment we can use it for agriculture, we can use for the construction also, and lastly this chemical industry.

So, in this particular introductory lecture, what we have seen that all these things that means, ion wise, so these inorganic cations basically we are talking about, so these inorganic cations can be useful for industrial purpose, where we have that these can be your starting materials. So, any of these materials if we make that can be useful for our chemical industry. Similarly, if we go for calcium and the material what we get from as the natural source like limestone or gypsum that can be processed for some other useful material, which can also be useful for our chemical industry ok.

Thank you very much.