Course on Analytical Chemistry
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Module No 01
Lecture 03: Methods (Contd.)

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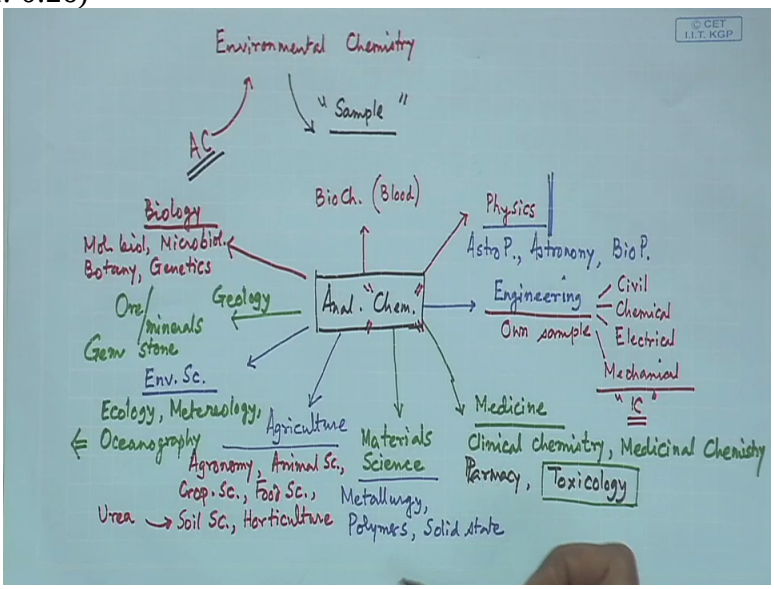

Hello, good evening. So we will be continuing the previous class which where we were talking about the importance of analytical chemistry on all spheres of our life starting from all branches of engineering, the medicine, physics and all these. So in our previous class, what we were talking about that if we can have our own samples from any engineering discipline, say chemical, electrical, and mechanical, as we were talking about the IC engine.

That means the exhaust and also the some other things, that means the fuel or any other thing which we can consume in this internal combustion engine that can be analysed because those analysis are very much important. So if we go further in any other branch say like medicine, so if we have some medicine, that means if we can have the corresponding analysis in terms of the clinical chemistry as we were talking about the sample of blood to treat some illness or your condition, that means how much haemoglobin you have ordered dissolved gases like O2 and CO2.

So clinical chemistry is a very major thing in all medicinal subjects and is nothing but what we consider as the clinical chemistry, it can be considered as the clinical biochemistry or clinical analytical chemistry related to the biological analysis and also definitely it will be related to the main branch of medicinal chemistry. So this medicinal chemistry when we talk about of any sample, so any unknown sample covering this medicinal chemistry, we can be it can be analysed.

Then, pharmacy and toxicology. So these are the branches which can be benefited from the knowledge of this analytical science we consider as typically analytical science when chemical knowledge or the analytical chemistry knowledge can be very much useful to find out something which will be direct related to the toxicology. So in a typical example in today's class possibly we will be able to discuss something, how toxicology or the determination of the toxic effect of some species to anything can be determined with the help of a simple knowledge of analytical chemistry, its methodology and some sets of ideas.

So the toxicology we will be talking today. Then if we go for another branch which is very much important to us is the characterisation of materials. So it is materials science. So this branch is also benefited from the knowledge of analytical science. That means the materials chemistry involving metallurgy, then analysis of polymers, characterisation and any solid-state material.

Suppose we go for, we make something what we all know that a very useful material which is present in the solid-state, so a superconducting material all we know that a superconducting material is very much useful and can be synthesised from typical knowledge of chemistry, solid-state chemistry rather and that can give us to something which is based on some copper oxides.

So if we want to analyse the percentage of individual metal ions present in that solid-state material which can be useful for its superconducting behaviour, so we have to take the knowledge of this analytical chemistry to analyse the solid-state material. Then we can have its application in the field of agriculture where we can see that there are several areas like agronomy, then animal science such as the animal feeds we can analyse.

Then, crop science, how the yield of crop can be increased. Then as I told you in our previous class that how food science can be benefited from a typical knowledge of analytical chemistry where we can analyse the food, the food material from its corresponding content of nitrogen.

That means the content of corresponding pin, then how we can analyse the corresponding soil delights of production of this crop, this food and all these things. So that is also related.

So soil, that means during that particular analysis, we know that the soil how we can urea, a fertiliser or the corresponding nitrogen content of the soil, that is how the ammonia content in the soil its present. So if the fertiliser urea is added and spoiled we all know has ureases also. And how much urea is there present, that can be analysed due to that particular involvement of this analytical chemistry in soil science.

And is also useful for the horticulture, in the flowers and all these things, how the flowers and all these things will be chemically dependent on some material, say the quality of the soil, the quality of the fertilisers and all these things. So those can be analysed from a typical knowledge of this analytical chemistry. Then comes over environmental science and as I told you that how we can analyse our environment.

So that will be dependent on the analysis related to environmental science where we can have the ecological balance knowing how the ecology is dependent on the corresponding presence of the different species or the different samples which can be analysed by using a typical analytical method. Then meteorology. Suppose we want to analyse the meteor. So meteor can be there. So that can give rise to some solid sample.

So that solid can be grounded, can be making their their powder form and that powder form can be utilised for the analysis of its corresponding elemental composition or the elements. So this meteorology and oceanography also where we can have some idea about the corresponding ocean, the tides in the oceans related to the corresponding contamination of the water content of the water quality of this particular ocean.

Then we can use this in case of the subject which is well-known to us, the geology that we were talking about in our previous class that how we can analyse the ore samples. So starting from this geology, the geophysics, the geochemistry and palaeontology, all will be benefited from a typical knowledge of this analytical chemistry where we can analyse the ore sample or we can have the minerals or as I told you earlier that how we can analyse the gemstones also where the

corresponding content of chromium as I told you that is present in case of the corresponding Ruby which can be analysed by means of this geological subject.

Then lastly, that means we are just completing the whole circular thing, that means starting from our biochemical to physics and all these things we will now reaching for the corresponding analysis or biological samples. So biology will also benefited from the knowledge of this analytical chemistry where we can find that the molecular biology also within this, then microbiology, then botany and genetics.

So these basically gives us some very good idea about the what are the areas we can cover but is not difficult to cover all these in this particular class that we can give some typical examples. Suppose we go for something where we have some material that how we can understand the corresponding nature.

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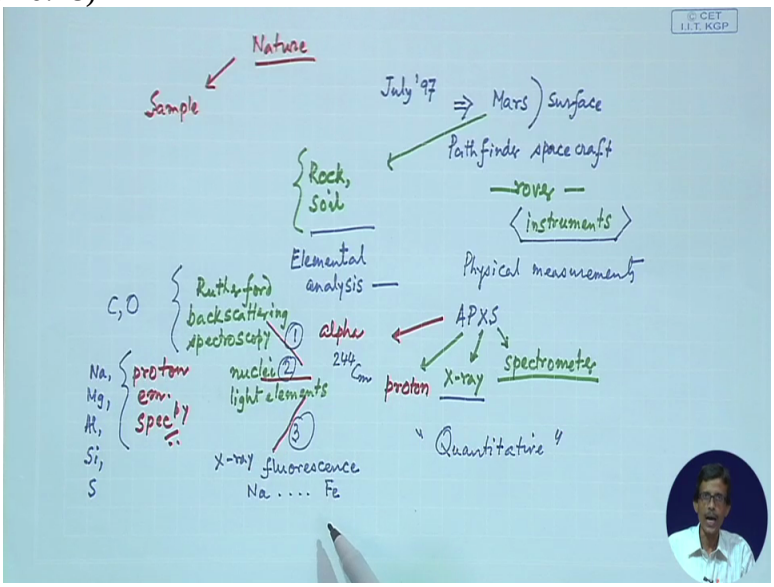

So if we will be talking about this particular application of analytical chemistry to understand nature. So how to understand that? That is typical, some sample. So from the mature, we should get some samples and I will give you some typical examples for that where we know that during July in the year of 97 we were exploring (())(11:17) Americans sent something to analyse the Martian surface, the mars and its corresponding surface.

So they sent the pathfinder spacecraft, the Pathfinder spacecraft was sent to analyse the corresponding elemental composition firstly because we will be looking for something, what are the elements present on the mars surface and this mars surface what we get as the corresponding Martian rock, so if we have the corresponding rock and definitely the derived soil also from the rock samples on the mars, so the spacecraft which is there also it has Rover attached to it and that Rover is basically utilised for carrying some instruments.

So that this is a very simple idea, that is what are the methods what we can use to understand or analyse? So if we go for the analysis of this rock and soil Sample and if we take the corresponding help of the instruments because this particular thing, that means the pathfinder aircraft which is carrying the corresponding instrumental part and if we consider this as the corresponding analytical tool, that means the instrument is our analytical tool, we can consider it as a typical instrumental methods of analysis.

And since it is on the mars surface and is a very complicated one and some physical measurements because we cannot have the analysis, that means the corresponding elemental advances, see our goal is to determine the corresponding elemental composition of rock and the soil Sample if we get it from the surface of the mass. So this elemental analysis can be done by using some instrumental technique and definitely we will be using the corresponding physical methods for the physical measurements because these instruments, continuously, they can collect for the several days during which the spacecraft was landed on the mars and was staying on the mars surface, that they were continuously collecting some amount of data and the data is being transmitted on the earth.

So what is that particular instrument? It is basically, I am giving some example, we will be talking when we talk about the instruments. So it is basically APXS. So what is this? So is basically something attached with a name of S is definitely a spectrometer. So if you are earth, what has been carried to the mars surface by this pathfinder spacecraft is the corresponding spectrometer and this corresponding APXS spectrometer is there.

And X is very common to us, very common to physicists, very common to chemists, is the corresponding x-ray and P is related to something which is very fundamental to our knowledge in terms of the electrons, protons and neutrons. So it is the proton. So all these things are known.

S is spectrometer. So it is carrying a spectrometer and spectrometer will be utilised for analysing the surface of the mars and is utilising x-ray and some perform is also involved and this A is nothing but the corresponding alpha.

That means, the alpha particle. So the full name of this instrument is alpha proton x-ray spectrometer. What it does? It does basically 3 things. So this spectrometer is doing for 3 things. We will be talking these 3 things. That means 3 types of measurements it can do. In the 1st case, that alpha particles. So you have these alpha particles, so alpha particles are there. So these particles are basically attacking the nuclei, nuclei of the elements.

What are those elements? That means the elements present in the rock and soil surface. The alpha particle + nuclei, the interaction of this alpha particle with this nuclei of the light elements, nuclei of the light elements causing some emission of proton. So this causes the proton emission. So basically we get something which is known as proton emission spectroscopy.

This is called proton emission spectroscopy. This is abbreviated as proton emission spectroscopy. So so when something is emitted, if we can have detecting mechanism, the detector will be there which can analyse the corresponding emission of this proton from that particular interaction. So this basically coupled with 3 advanced instrumental techniques, so is definitely a very complicated one.

So during our course, separately we will be learning how a spectrometer or spectrophotometer can be useful for a radical chemistry or chemical analysis. If we use x-ray as the source of radiation, how x-ray can also be useful. Then something related to the nuclear chemistry. That means alpha particles are heating and protons are it from there which can give rise to a corresponding emission of proton and that is giving the corresponding spectroscopy.

So what basically gives us from this is that this particular thing, that means the alpha particle what is emitted from there and we can analyse this proton emission spectroscopy because this alpha particle is coming from a source of coria which is 244 coria which is a source of alpha particle that can give the flow that can emit some alpha particle from the spectrometer and which is attacking the nuclei of the light elements.

Why we are doing so? Because this particular information can be helpful to us for the identification of the sodium, magnesium, aluminium, silicon and sulphur. So if these are present, all these elements are present, because our basic idea as I told you, is that elemental analysis with the help of an instrument and what we are doing? We are getting the samples from a very remote source which is nothing but the mars.

So these are basically, that means the corresponding composition, that means whether sodium is present, magnesium or sulphur and their some amount of the percentage and these percentages are also very less. So the elements, so the elemental identification is possible with the use of these instruments. And what about the 1st one? The 1st one is the corresponding x-rays are used. So these x-rays are utilised for the corresponding thing.

That means the it is known as Rutherford back scattering spectroscopy. So name may be complicated but you just listen. It is the name of the scientist, Rutherford back scattering spectroscopy. So you see that all our spectroscopic things. So the analysis is through spectroscopy. So that is a very important and the major part what we will be talking afterwards that spectroscopic analysis, instrumental analysis is nothing but the spectroscopic analysis.

So what basically gives us this Rutherford back scattering spectroscopy like this of your corresponding alpha proton interaction or alpha proton alpha particles are interacting with the nucleus, so this Rutherford back scattering spectroscopy is basically giving us the corresponding identification of carbon and oxygen.

So this is a very important information what we will be gathering that whether the surface of the mars can have the corresponding carbon content present in it because the carbon content present in it has some direct relationship with the uhh uhh presence of the corresponding living thing. That means the plants, that means the animals thing or something which can give rise to the corresponding composition in terms of the presence of the carbon.

So carbon, oxygen and all other these elements can be identified by these techniques. So this is number 1, this is number 2 and the 3rd is basically utilising the x-ray. So x-ray and a particular process which is corresponding fluorescence. So if we can expect fluorescence and these are giving rise to corresponding elements like from sodium to upto in the periodic table, so large

number of these particular species which have a very characteristic fluorescence pattern that can be identified the way we talk in terms of the corresponding frame test in our school days that the sodium we all know that giving rise to the flame, a characteristic colour of this flame.

Similarly other elements also, potassium can also give rise to the flame test. Similarly is a particular technique, the emission techniques. X-ray is utilised for the excitation and when the emission is taking place in terms of its fluorescence, so that can be analysed for all these elements. So quantitatively, so this elemental analysis is basically giving rise to some quantitative estimation. So this quantitative estimation is possible in terms of the corresponding percentages of carbon to say iron.

So we get something related to this particular type of analysis.

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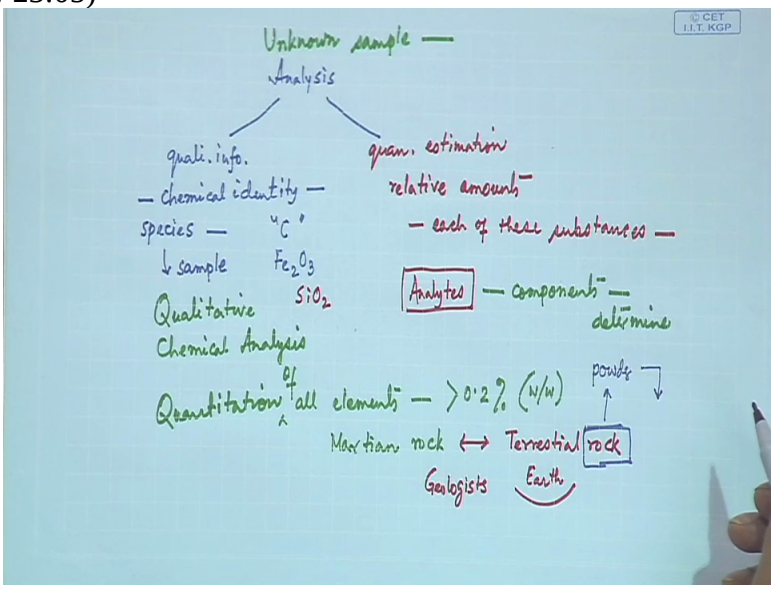

So any kind of this analysis if we can have, 1st thing that whether we go for a solution analysis or a solid-state analysis using that, we initially get something which we consider as a corresponding qualitative information. So qualitative information what we can get, that is also known as the corresponding qualitative analysis. So it is required for establishing the corresponding chemical identity of the material because whether we are getting some material as a carbon or that material as iron.

So chemical identity of that particular species which is unknown species, so species is known to us which is present in the sample. So if we have so this particular species, so if we can have, so carbon-based some compound or summarising or its compound, say as I told you that it can have some oxide or any other composition, that means the oxides, sulphides and all these things. So this qualitative information what is giving us, give rise to some analysis which we can term as the corresponding qualitative analysis.

So is known as qualitative chemical analysis. So this is important because what we are talking about about the Mars surface is the elements which are available on the Mars surface, so quantitation so quantitation of all the elements which are present over there except hydrogen and helium because hydrogen, helium cannot be detected through all these 3 different techniques, 3 very advanced level of these instrumental techniques and this concentration is in the range of greater than 0 . 2 which is not always very easy to do by conventional analytical technique.

What will be learning in our next class is that a typical analysis after identification, that means after qualitative identification, we can go for the corresponding quantitative analysis. So in case of quantitative analysis, so the other part is the corresponding quantitative estimation, that means the detection of carbon, the detection of iron, detection of sulphur, detection of the surface as its if it is silica is present, that means silicon-based surface is there.

So silica-based surfaces can also be identified and this particular percentage which is greater than 0 . 2 percent only weight by weight, so the small percentage of all these elements which can be detected by this particular technique and the amount is also this particular quantity. So it basically gives rise to some relative amounts also. The relative amounts of all the species which basically indicates us that how these each substances are present.

That means each of these substances which are present in this particular sample, so this unknown species which is there and which we have analysed, so these are known as analytes. So this is a a typical terminology which we will be utilising or which we discuss by us, we will discuss this. So there, in these analytes, we try to understand that what are the components present which we can determine. So anything which is unknown, so any unknown sample here at the top basically we can have the unknown sample and our basic idea is that how we can analyse this particular unknown sample. So we have to go for typical analysis. So this analytical technique will be

available such that we can determine the corresponding elemental composition if we go for elemental analysis such as we are determining the Martian rock.

So from Martian rock, basically if we can have we are talking about the Martian rock, do not worry about all these things. That means it is can be very sophisticated or a very advanced technique you can think of but if we can have idea that how far you can go, how useful this subject is by knowing the corresponding composition of the Martian rock, its development and it is ultimately how it is giving rise to some other transformation from there to that of our terrestrial rocks.

That means, the surface of our earth. So anything is available from there, so this is there that means the typical earths surface because still we do not know, there are several places, several mountains, several rocks and all these things we do not know the composition of all these. So geologists are very much engaged to understand the corresponding analysis of these rock samples. So basically we will be utilising initially the identification, the qualitative information, then the quantitative information to understand these and remember that we just do not be very much involved with the sample.

So if we have the rock sample and if this rock sample is given to you as a powder form, so it is like anything. That means any unknown sample what we get and what we can analyse from our schooldays, in our colleges in the laboratory classes. So only thing that the origin is different. So rock samples whether it is a terrestrial rock or a Martian rock, you make it powder.

So this powder we can analyse. So what are those things and what are the difference steps and what are the methods and the procedures we can adopt to analyse this sample which is an unknown sample and which is in the powdered form to utilise for the corresponding analysis whether we are utilising some instruments or we are going for standard titrametric or some other technique for this typical analysis okay? So that we will see in our next class.