Non-ferrous Extractive Metallurgy

Prof. Mr. L. Pugazhenthy

Department of Metallurgical and Materials Engineering

Indian Institute of Technology, Kharagpur

Lecture No. # 40

Nonferrous Metals in India - Unleashing its true potential (Contd.)

Welcome once again my friends. In the previous lecture, we have talked about the way India has evolved itself in non-ferrous metals with the primitive history lost our way in between, then it has come back to where it was originally its preeminent position, how the various government policies curtailed or suppressed the growth of the non-ferrous metals industry. And after the economic liberalization, how opportunities have unfolded by itself and the Indian companies going in a big way in global acquisitions take over of mines, takeover of downstream companies, international companies trying to come to India to exploit its natural resources and the way the production, consumption, usage of non-ferrous metals has been consistently witnessing impressive growth rates during the last few years.

(Refer Slide Time: 00:57)

And we concluded by talking about what kind of strategies Indian government, India as a whole should adopt in mining, in exploration, in R and D, in market development and in creating a sustainable energy environment friendly recycling industry in this country, that is where we concluded. Now, let us look at the downstream applications, the markets, for for instance one of the metals, how the growth of metals, steel or non-ferrous metals, their future, their fortunes are very closely linked with the economic growth of our country.

(Refer Slide Time: 02:40)

If you look at this picture, we are going to be talking about the various downstream applications of zinc and lead, what are the key drivers the motivating forces for increasing the consumption of zinc and lead? In the case of zinc, more and more of zinc is being consumed by the steel industry by coating or galvanizing of various steel items as I said in my previous lecture, sheet, steel sheets, corrugated sheets, plane sheets, galvanized steel pipes, galvanized structurals in various applications, galvanized drums, and galvanized buckets. So, more and more of zinc is being used in the steel industry. And therefore, the future of zinc, the fortunes of zinc very closely linked with the steel usage pattern in any country.

The other factor would be whether a country that particular country has got enough of domestic protection of zinc, domestic availability of zinc to use in various applications; one is the steel, the other is zinc availability. Now, more and more of steel and more and

more of non-ferrous metals, they are all used in several infrastructural sectors. Steel is noticed very prominently and non-ferrous metals are also there, which are not visible enough, but I am going to be highlighting, where they are used for instance. In infrastructural sector as I mentioned in the previous lecture, the aluminum conductors carry the electricity produced in one location to a destination user point, several hundred kilometers away.

And all those transmission line towers, power transmission line towers, they are made of steel, mild steel angles and this is one structure, which should be protected from corrosion and there are several methods of corrosion protection. You can electroplate here steel article, you can paint the steel article; you can have the metal coating, metallic coating and that is zinc comes readily, each non-ferrous metal has very specific property advantage. Zinc is an excellent corrosion resistant material, zinc also gets consumed in the atmospheric reactions, but at a very very slow rate of attack; it consumed very slowly and therefore, it is able to prolong the steel, which is coated with zinc.

Now, the transmission line towers are one such structures, which have to be maintenance free for a long time, you cannot think of maintaining a transmission line tower periodically every 2, 3 years, which means you have to shut off the power supply and the users, they do not get power for several days; industry production comes down, the agricultural pump sets would not work, because there is no power and there are vital structures, vital establishment like a hospital for instance, transport movement, communication this have these need electricity continuously, which means the transmission line towers have to be maintenance free that is here, zinc is coated on the transmission line tower made of steel.

And power is one, one of the infrastructural growth areas, where government is putting lots and lots of money to increase the power generation in the country to meet the future needs of power. So, in the infrastructural sector, zinc is used very widely, power is one the railway electrification towers, transport sector, railway electrification steel structures, they are all coated with zinc again for maintenance free protection. You are also seeing plenty of mobile phones with everyone now, everyone having two mobile phones or three mobile phones personal, official, all those things are happening in the country.

Now, So much of mobile growth, telecom growth you also have to have cell phone signal towers erected on the roof tops, on the highways and unless these signals you get in your mobile, your instrument does not work.

And cell phone towers again are protected with zinc, galvanizing hot dip galvanizing to give a maintenance free protection, there are many installations like power transmission, telecom structures, railway electrification structures, which need maintenance free protection for a long time 30, 40, 50 years depending on the coating thickness, zinc coating thickness you apply. And therefore, in the infrastructural sectors, telecom, power, transport, many other area highways, which you will be seeing later, zinc is used plenty.

Coming to lead again, let us have a look at the driving forces, the motivating factors; one is lead is used as you saw in the previous lecture about 75, 80 percent of lead is being used in the lead acid batteries, lead batteries. Now, most of the batteries they are all used in the automotive vehicles which we use, whether it is a passenger car, a scooter, a sports utility vehicle, a bus, a coach whatever you think of all of them are powered with lead acid batteries for starting lighting and igniting the engine.

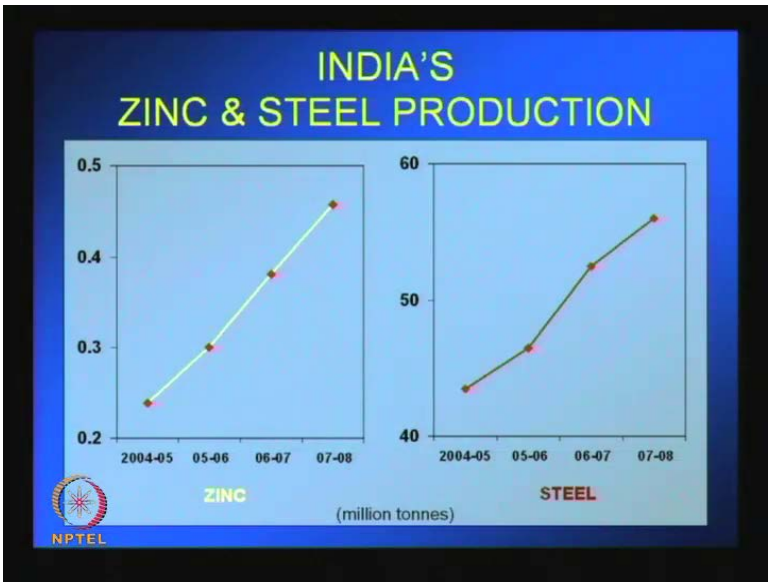
Nowadays, the requirement of energy per car has also increased you have lot of power driven devices in the car like, the wind screen going up and down you have the button and that is motorized and for that, you need energy from the lead acid batteries. So, the energy requirement in a car has also increased apart from starting and lighting and your wiper blade moving in the car, when there is rain, etcetera. There are many things like, CDs and radios and the many things operating in the car, all of which need power. So, the lead acid battery is a very essential key input in an automobile industry. IT industry again computer industry; each computer has to have a backup, because in our country various parts of the country you have power shutdown, when power goes, when it comes very unpredictable particularly, in summer months.

And therefore, you have to have an energy backup, uninterrupted power source for your computer and that is again having the lead acid battery, a portable energy source. Power supply again power shortage in many part of the country and therefore, inverter energy backup for the houses, the banks, railway stations and hospital, schools, colleges, technology parts everywhere you need energy backup; that means, an inverter. Rows and

rows of lead acid batteries, which give continuous power supply, even if there is a power shut down. Therefore, lead has these factors automotive industry, IT industry and the power availability in the country, which decides the growth of the country.

Lead and zinc are linked with these various factors you see beautiful pictures ingots of zinc, ingots of lead which are made from natural resources or from even secondary sources that is, those waste products are scrapped material, which contain lead or zinc, which is recycled and reused, recycled, reused, etcetera continuously.

(Refer Slide Time: 12:32)



Now, as I told you in the initial remarks, the future of steel and the future of zinc industry, they are very closely interdependent very closely interlinked. In this picture you see, the zinc production from 2004-2005 to 2007 - 2008 that you can see in terms of million tons 0.25, 0.23 going to about 0.45, 0.46 continuous growth. And it follows a very similar growth in steel production on the other side, that is in million tons 40, 50, 60 on the y-axis you see that, steel production million tons, but the interesting thing is both are very closely following similar, growth patterns in production.

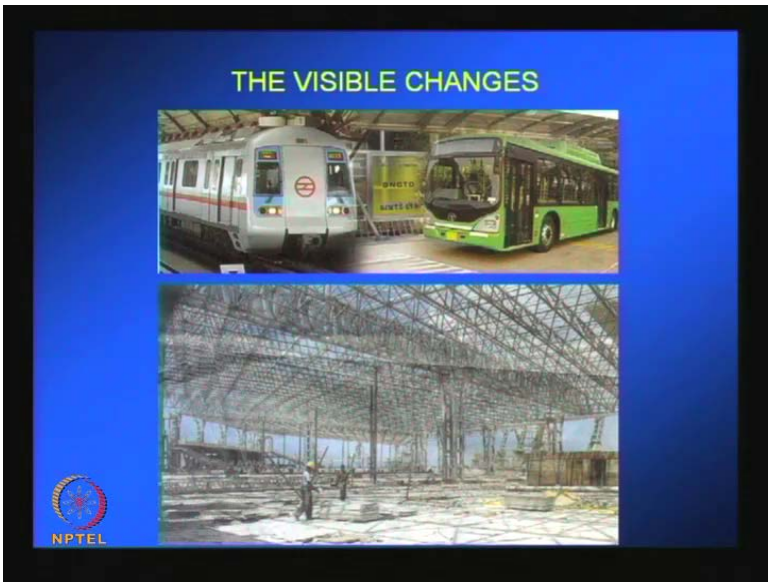
More steel you produce, more zinc you consume, more steel you use in the country produced in the country or imported into the country, more steel you use in the country, you need more zinc for coating them 80 percent as you saw goes in galvanizing of various steel articles.

(Refer Slide Time: 13:55)

I was telling you the future of India, how we we are putting plenty of money, huge investments in various infrastructural sectors, what you see here are the investments during the 11th five year plan period 2007 to 2012. Power, telecom, highways, ports, aviation all these sectors, so much money is flowing now, GDP growth is there, the people want new style of living, they want new products, new services suppressed demand in the country.

And so much money is being put in this sectors; aviation, you see most modern airports coming up in the country, smaller airports are being upgraded and new airports are coming, sea ports again, the port expansion is taking place in the country and highways you see; so much happening in this country, two laning, four laning, express highways state (( )) highways that is coming up in the country in different parts and there, we are going to put lots and lots of money as you are seeing here. Telecom again, India is the fastest growing mobile market in the world after china and power again, India needs huge amount of power; one for the growing population and also for the other uses like, industrial, agricultural uses etcetera. Therefore, we do need lot of power generation to be increased and therefore, so much money is being put in power sector, so that is the way things are geared up.

(Refer Slide Time: 15:56)



And you see now, in this picture what I mentioned earlier, so much money flowing, the governments intension and the people looking for these kind of facilities, the metro which used to be in Calcutta now a success story, the most modern metro transit transport system has come in Delhi; the world leaders are appreciating the facility, that has come in Delhi. Rapid transit systems and this is now coming up metros are coming up in other cities too in Mumbai, in Hyderabad, in Chennai, etcetera and also the buses, the public transportation, the coaches the type of coaches you see in the country as you see anywhere else in the world this the order of the day.

The more and more such coaches, high capacity buses or peak traffic movement and they are, they are all some of them air conditioned, some of them are non air conditioned having plenty of non-ferrous metals engine blocks for instance they are all huge aluminum engine blocks there, plenty of lead acid battery there, for such a heavy vehicle to be moved and started and lighting etcetera.

And what you see in the picture, the lower picture is an airport complex, a new airport complex just coming up. So, much metal is being used, so much steel is being used and many of them are coated with zinc, galvanized steel and the roofing sheet that you will use, they will be color coated or repainted steel sheets, color coated means the steel sheets are coated with zinc a coating on the top of the steel and above the zinc coating you will have various organic colored coatings to give a good visual appearance blue,

green whatever colors that you want. So, much of non-ferrous metals are also being used there, when this kind of new airports up gradation of airports are coming up etcetera.

(Refer Slide Time: 18:23)

And this is the order of the day. Now, what is the story now, now what are the various markets in India, where India suddenly coming up in a big way. You have conventional applications of galvanized material sheets, corrugated sheets for roofing, sheds, and etcetera. GI pipes, zinc coated pipes bringing water to the homes and offices, schools, etcetera.

And the galvanized fencing wire or the barbed wire, etcetera. These are all the established applications and even the others like I mentioned earlier, the transmission line towers coated with zinc galvanized transmission line, tower galvanized telecom or cell phone signal towers, galvanized railway electrification towers, they are all steel basically, but they are coated with zinc. These are all the proven well established markets in India.

Now, the money that is coming up, the investment that is being put in the infrastructural sectors that has thrown up again new markets for many metals, non-ferrous metals in the picture that you are seeing.

The highway there, beautiful highways two lane highway and you see there, highway guard rail running on both sides, which used to be the order of the day, fashion of the day

in other countries, highway guard rails crash barriers for safety of the people, who are driving at high speeds and there are no men or cattle crossing across etcetera, this kind of crash barrier as we call it or guard rails. They are now common thing in India and they are all special steel sections coated with plenty of zinc again galvanized guard rails or crash barrier and that is going miles and miles and miles across. The lower picture you are seeing here construction material ribbed bar reinforcing steel.

Normally, we use steel reinforcing in the RCC structures columns in our entire infrastructural activities or buildings etcetera, but in coastal areas; where corrosion will be a major factor, any construction in the coastal areas; it could be a bridge, it could be a flyover, it could be a water tank, it can be a different establishment. So, all these places where the concrete will be prone to attack and later on the attack goes into the reinforcing steel, which is attacked by the corroding medium and there is a rust formation on the steel, there is a expansion volume expansion of the rust.

And that volume expansion leads to removal or disintegration of the concrete layer on top and then, you have the ugly signs of patches and concrete having fallen off and you see rust stains and weeping rust weeping etcetera, which is an ugly sign. Now, such areas where corrosion can be a major nuisance you do coat them with many materials and one of the most common, which are used in many countries Australia, South Africa, United States, etcetera is to galvanize them used to coat them with zinc and put the zinc coated reinforcing steel in such infrastructural projects such RCC structures.

In coastal areas, where by corrosion will be minimized and the concrete cracking or rust stain etcetera will not take place therefore, for this another market the lotus temple in Delhi, the Baha'i temple they have used about 300 tons of reinforcing steel and that is a monumental structure to last for about 200 years without any rust, without any concrete cracking something like, Tajmahal for instance a white structure and that is why, they used 300 tons of galvanized rebars.

Copying the example of the Sydney opera house in Australia, which is right in the sea water; it is exposed to sea water continuously, so that model was taken as an example and in India, in Baha'i temple we have used this.

Similarly, if you look at many constructions in in and around Bombay; very heavy monsoon there, marine conditions, saline condition, corrosion is a nagging phenomenon

there. So, in Mumbai and many other locations including Ahmadabad; a river project, they have used galvanized rebars.

Now, the idea here is you are able to prolong the life of RCC structures without any need for maintenance, without any need for touch ups in between. So, galvanized rebar is another huge unfolding market especially, when you are putting lots and lots of money in infrastructural project including the highways, etcetera in the coastal belts. You see a middle picture there, that is your telecom tower, cell phone mobile tower this is a common sight now, and all of them all the steel structure there is again coated with zinc, molten zinc through hot dip galvanizing.

And later on, they are given different color codes red and white, etcetera for identification purposes. So, that is again a common application that you are seeing in the country, new market. And the one that is standing there, a high mast lighting column, the huge tall lighting column. And these are all galvanized in two, three assemblies and then, they are put one above the other and then, its erected and these are all again galvanized hot dip galvanized and these where originally imported India used to import these high mast lighting columns, a few years back, but now you have more and more of domestic players in India, Calcutta, Pune, Mumbai many of them galvanizing these high mast lighting columns, they are very common in the airport complexes, in railway yards, in vantage points in cities above the flyovers etcetera.

So, that you are able to eliminate at a very significant height, a large area very bright illumination all around and that is again coated with molten zinc again that is another infrastructural sector electricity being used very wisely and to light many parts of our highways and the airports, seaports, railway yards etcetera.

(Refer Slide Time: 26:23)

Now, what you are seeing here power generation, you are seeing the transmission line towers galvanized in the back drop of sunrise or sunset and that is going miles and miles and miles and all of them steel with zinc galvanized transmission line towers. And by 2012, the government of India wants to add 90,000 mega watt of electricity in the country to upgrade and that we will be achieving by new power generation capacity and also expansion of the existing players.

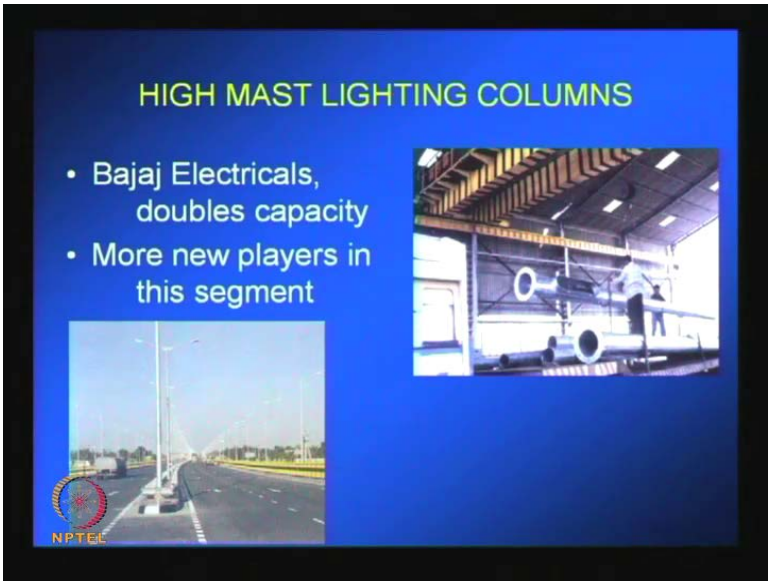
Now, this kind of power sector growth we also need plenty of transmission line towers to carry the power to long distance safely and economically. And 11th five year plan as per the projection we need about 700,000 metric tons of transmission line towers, so much of steel and so much of zinc for coating them, maintenance free protection as I said earlier. Now, because of this kind of a growth in power sector, there are many new players entering this growing market and also the existing player also expanding their galvanizing capacities to meet the emerging demand of transmission line towers from this sector.

And let me also tell you one is the domestic power sector growth and India has been a very important turnkey player to many countries in supplying transmission line towers erecting them, installing them, designing them, testing them and putting them into efficient operation in many countries, many developed and developing countries you will

see Indians having put up such transmission line towers over long distances in Africa, in Latin America and Australia.

So, India is also a big player and that means we have shown our expertise in galvanizing, in designing, in erecting them and we have master the art of with transmission line tower business. So, this is the way India has been growing both domestically and internationally.

(Refer Slide Time: 28:49)



Now, you are seeing high mast lighting columns and the picture there right side, a shop floor picture, where they are trying to galvanize high mast column in pieces that is probably the base, which you are seeing there. And the thing and they just put one over the other after galvanizing segments. Now, Bajaj electrical is a big player in the country and because of the growing demand, they are doubling their capacity and as I said earlier, more and more new players are also coming into the business of galvanizing or zinc coating this, high mast lighting columns.

The other picture you are seeing, a typical city. Now, in India nice highways, but what you should also notice is the galvanized lamp poles for many many decades India; we used to be painting them with aluminium just to give a corrosion protection, but for a very short limited life paint does not give a long life; it could be there for 2 years, 3 years, 1 monsoon or humidity in the location will eat away all those paints, the paints get removed, the underlying steel starts getting affected by corrosion.

So, they were giving short term protection, but today many public works departments, central public works department, many city municipal corporation, they have realized instead of giving repetitive painting, which is costlier in a very short time, it is better to give a slightly costlier 15, 10 percent costlier protection method, coating material through zinc 10 to 15 percent more. But you get an advantage for life may be 40, 50 years without any touchup needed there, maintenance free protection and you save lot of money also. So, that is the thing that you are seeing in that picture.

Now, telecom sector again I told you earlier, mobile India the second largest mobile wireless market after china. A few years back Ernst and Young, they did a study about a mobile market at that time the mobile subscriber used to be 336 million in this country. Today, you will be surprised we have just crossed 500 million that is 500 million, they are having mobile phones in this country and almost every month every month we add about 10 million mobile phones.

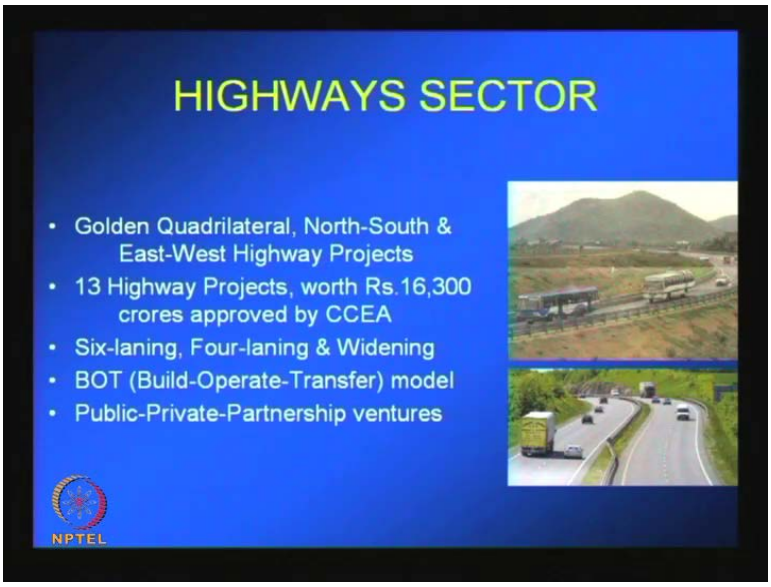
Mobile phones again as I told you earlier, the body is made up magnesium for instance, a non-ferrous metal is light in weight and every month we are adding 10 million and this kind of a growth you will need about 90,000 to 100,000 cell phone signal towers, telecom towers per annum 100,000 towers per annum, which is a huge growth you are seeing the picture there, a cell phone structure there, passive infrastructure as it is called many times, it is very passive, it is not playing any active role it just communicating the signals to your instrument and by march 2009, we had almost about 250,000 towers this kind of towers galvanized with steel, zinc and then, painted later on.

Now, at that time when they did a study, Ernst and Young; the teledensity in India was only 32 percent that is out of 100 percents, only 32 percents were having mobile phones that time currently it is around 40, 42 percent now, which is a good going, it is a good growth and, but 2012 in another 2 years, 60 percent of mobile users in rural India you would be seeing across the country; that means, more and more rural market penetration.

Plenty of mobile phones you will see in the the hands of agricultural farmers and those who are doing other activities in the rural areas, they will all be having mobile phones; it is easy for you to talk to them, it is easy for them to talk to anybody they are alive in Delhi or whether their sons are in other parts of India or overseas, they will be able to

talk to them without any limitation, so that is a way telecom sector also is growing in this country.

(Refer Slide Time: 33:55)



Highway sector you see beautiful pictures here we never had good highways, highways are very essential for the country for rapid moment of material men goods etcetera and you see the state of the highways coming in the country after long long time. And the government has got some prestigious projects here, plenty of money again here, golden quadrilateral that is connecting the four metros, Delhi, Mumbai, Chennai and Kolkata that is a golden quadrilateral project and North-South, Kashmir to Kanyakumari and East-West may be Guwahati to somewhere in Gujarat, so that is going to be East-West highway projects.

So, crisscrossing and also golden quadrilateral you will have this kind of express highways, the point that I am trying to tell you is, you will have plenty of steel use there and plenty of zinc also used there for corrosion protection of the guardrails, the lamp post, the sign post there are many other structures, which will all be coated with a non-ferrous metal and country is going for six-laning, four-laning widening etcetera.

Now, many of them have different models, they just build the owners, they build operate for some time and then, transfer it to somebody else. And the public-private-partnership venture; it is not only the government, which is putting money, they are also joining hands with private sector from India from companies in countries like Malaysia for

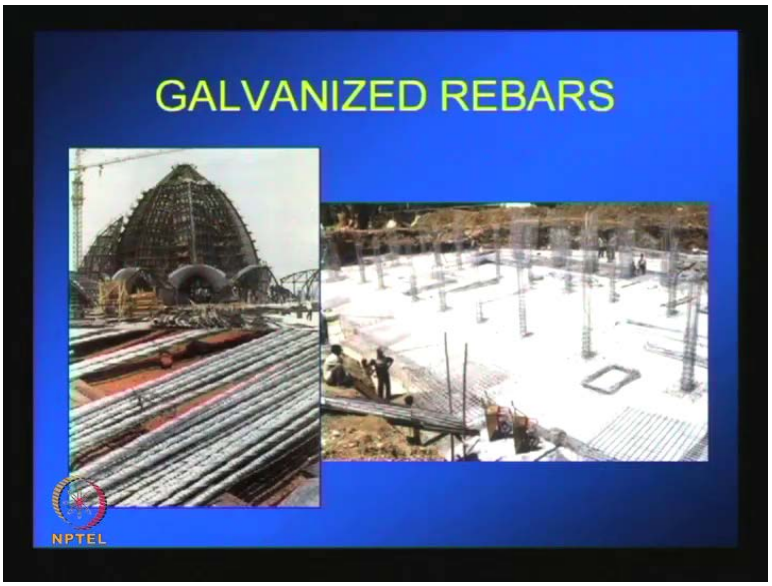
instance joining hands with many other so that you have global facilities, global highways in this country.

(Refer Slide Time: 35:44)

Again you are seeing here metros, metro transport which is now becoming a common thing Delhi beginning and then, other cities are all now active with their metro projects. Now, what you are seeing there in the metro coaches there and above that, you see the electrification structures; which are all steel and then, again coated with molten zinc or galvanized steel. And the other picture you see you have blue sheet that is a metro railway station and these are all again galvanized and then, given a color code sort of a blue coating on top and that is again coated with zinc underneath.

And what is happening here is, there are more and more metros are coming up in the country which means plenty of steel, plenty of zinc, plenty of color coated product you will see all this coming up in this sector.

(Refer Slide Time: 36:43)



Galvanized rebar I mentioned to you that, Baha'i temple, lotus temple in Delhi. The one that you are seeing in a reconstruction stage today, if you go and see it looks beautiful white marble piece like, Tajmahal and that is an early stages of construction you can see the crane there and below that, you see galvanized reinforcing steel, 300 tons of galvanized rebars, which we are used inside, so that there is no need for any touch up, any repair or maintenance during the life of the lotus temple, monumental structure 200 years as I told you earlier; no way it should have any defects in the building and that is how, galvanized rebar was chosen.

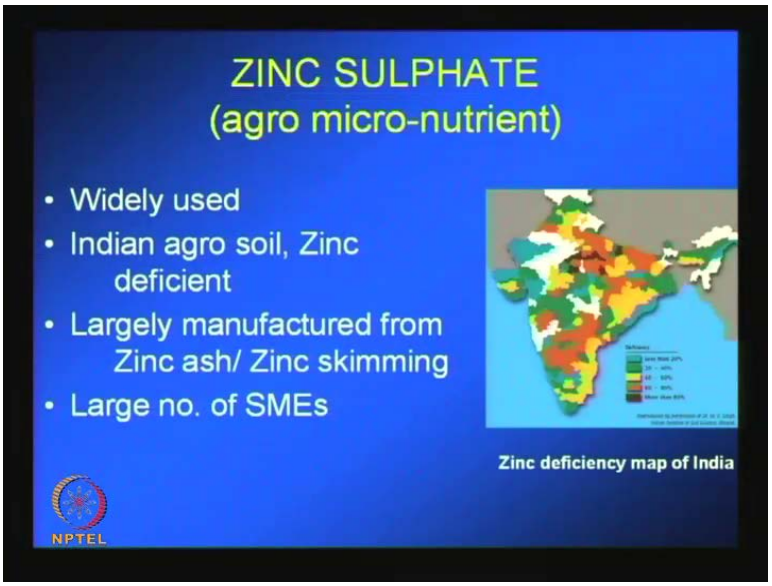
And other picture you are seeing during construction stage, a guest house in Mangalore, again a coastal town, where corrosion can be a nuisance buildings will have limited life, this galvanized rebars have a huge opportunity in this country; it is unlimited I would say and the way we are putting plenty of money in our infrastructure projects, airports highways and seaports etcetera, in the coastal area particularly. Are those areas where constructions are being done, where the water that you will be using for concrete mixing contains high chlorides. There are some specific locations in the country where the water could contain high chlorides and there you cannot use a normal steel and (( )) no time and therefore, you will have to go for galvanized rebar there. So, this is again another application, where we are not exploited fully and the markets are unlimited here applications are unlimited.

(Refer Slide Time: 38:41)

Here you see another application in the right side, beautiful bathroom fitting a gold plated wash basin, bathroom fitting there and there you that is a zinc die cast product. We have plated with gold containing medium, gold plating and that is again using die cast component. And on other side, you see small die cast components under the market potential pictures you see small heat sinks, this these are die cast component which are used in computers, in TVs. When you use them continuously they generate so much heat and that heat has to be absorbed by a component and dissipated. Otherwise, you will have overheated electronic gadgets and this heat sink essentially, absorb the heat anticipate the heat and very small precision gears whereas, you see in the bottom picture, they are all zinc die cast very delicate intricate tin wall products are all die cast.

And then, you have the hot chamber machine, which are very essential for casting of a zinc, zinc die cast components and there hot chamber machines you have such an operation, whereby you can produce about 10 million components over a period of time is the fastest means fastest methods are available through die casting by which, you are able to convert a molten metal to the finished product in the shortest time possible and million pieces coming in this kind of a machine, which is very good for the meeting the needs of the automobile sector, the IT sector and other sectors etcetera.

(Refer Slide Time: 40:43)



Now, you are seeing another application growing application in the country zinc sulphate, which is a very essential micronutrient in the agricultural sector of India. Now, many parts of the country as you see the zinc map there below that, you you have a write up zinc deficiency map of India, the soil contains all kinds of metals minerals and due to continuous crops around the year, the zinc level gets depleted, zinc level gets reduced and that is how the zinc deficiency has been noticed in many parts of the country and the various colors indicate different levels of zinc deficiency.

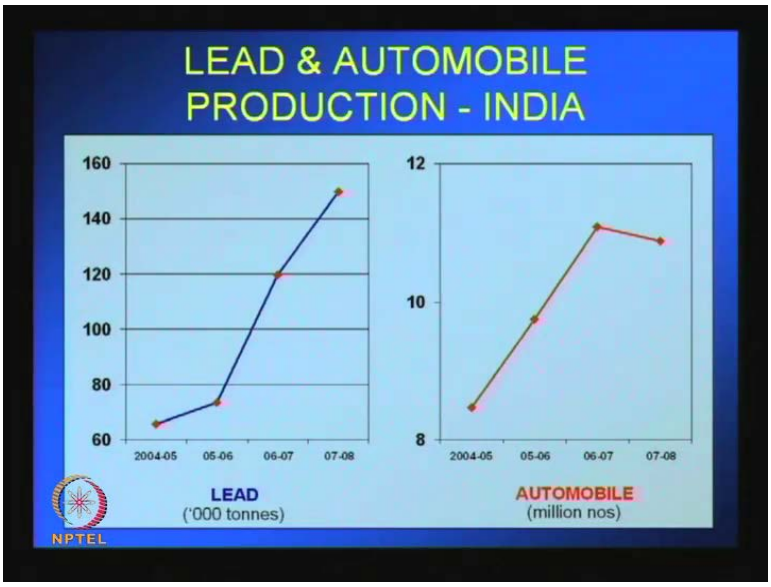
Now, this zinc deficiency has to be made up by some other means, the way that we adopt is the zinc sulphate is mixed with other fertilizers NPK or urea and then, these are all sprayed into the soil and the zinc sulphate gets into the soil and there by, the zinc level in the soil goes up. And what happens is once this zinc level goes up in the soil any produce that you get from agriculture, whether it is vegetables or grains or rice or wheat or whatever, they all take that much zinc from the agriculture soil and these kind of agriculture produce, they contain sufficient zinc in them.

So, when human beings or cattle or animals when they use various agricultural produce, they also have this zinc intake going into to the human body and every human body needs a particular level of zinc. Zinc is very essential for health as a nutrient and other minerals also, other metals also which I am going to be touching later, very essential for

human metabolism for our health for the various attributes of good health or wellness as I would call it.

Now, this zinc sulphate is very widely used in the country, very widely applied and they are now they are largely manufactured from the zinc ash or zinc skimming waste products. These are all inevitable waste coming from the galvanizing plant, the waste generated during galvanizing contains high levels of zinc and therefore, they are recycled. They are converted into zinc sulphate, which is a good thing good in the name of sustainable development, therefore we are able to convert your waste product from one industry to an useful material for the agricultural sector. And a large number of SMEs small and medium enterprises, small companies manufacturing zinc sulphate they by the local zinc or zinc skimming from the galvanizer and that is converted into zinc sulphate and that goes into the soil.

(Refer Slide Time: 43:57)



Now, coming to this story, lead automobile as in the case of zinc as I told you the future of lead is again linked with the automobile industry in any country more so in our country. Here you can see lead production in one graph in 1000 tons that is primary lead mostly we have not taken the lead recycled secondary lead into that picture. But whatever it is, the important thing to be noticed is the lead production and the automobile production in million numbers, they are more or less following the similar growth trend.

More automobile production, more lead acid batteries there is a small dip in 2007, 2008, when the prices of various non-ferrous metals went very high then, the production of automobiles suffered. The demand from the consumers were less and that is the way the production went down during a particular time, but later on the stimulus packages announced by the country, the interest rates having come down, the loans being made available for vehicle purchase etcetera. The automobile production is again increasing, but the point is the growth trend is more or less similar both in lead and in automotive industry.

(Refer Slide Time: 45:18)

This is the point which I told you earlier, quite in depth lead acid batteries, the growth trends in India; the galloping automobile population, all the global players in two wheelers, three wheelers, four wheelers coachers they are all in India manufacturing different types of vehicles. And all of them need lead batteries for various starting, lighting, igniting etcetera applications. Power invertors, the power backup for various parts of country, that is again another growth area. UPS for computer UPS for computer backup for the computer that is again a lead acid battery instrument there.

Now, the other aspect which our country we are putting lots and lots of emphasis and lot of money is going to come flow into this area also solar energy, wind energy etcetera. Now, in these cases when you generate energy, whether from solar means or from the

wind etcetera you have to store this energy and after storing, it has to be taped for various applications, which means there is a need for a storage battery there.

Therefore, that is again another growth area many parts of the country in Tamil Nadu, in Gujarat, in Rajasthan you see lots and lots of wind mill towers coming up; it is something like what you see in Holland perhaps. So, these also will need lead acid batteries for storage and the last one is the electric vehicles, battery driven vehicles when the price of oil, the petrol, diesel etcetera goes up everyone looks for alternatives, whether you can reduce your petrol or diesel usage or whether you can have any other means CNG driven vehicles or lead acid battery used in electric vehicle for instance.

These electric vehicles is something which is catching up very fast in the country, the two wheelers we have made a success, Honda for instance, Hero Honda come up with number of electric scooters, TVS scooters they have also come up with number of electric vehicles battery scooters and these are all running for limited distances. There is a battery there, you charge the battery you start the vehicle, drive noise free, pollution free, silent riders and once you run for 60, 70, 75 kilometers when the battery gets discharged again you go for charging them in your house, in your office and then, again you charge the battery and you take the vehicle for further movement.

And this is again a growing activity and some parts of the country already companies have come for setting up charging stations, battery charging stations, where you can go and get your battery charged (( )) house or office or you will have readily charged batteries, which you just take and give your discharged batteries, put the charged batteries and you start keep moving. So, this is again a growing thing that is happening in the country you all would have heard about reva a electric vehicle from Bangalore small car and the government both center and state, they have given lot of incentives now, by way of taxes, by way of insurance, by way of waving registration for the vehicle etcetera, they want to promote more and more of electric vehicles especially, if it is going to be single driven or for a small distances or travelling within a city and this electric vehicle is catching up now practically, all the vehicle manufacturers are also working on this.

Now, Nano will be again Nano today will be a petrol driven car, but very soon you will find it as a electric vehicle; it is there, it is in their agenda and similarly, Mahindra and Mahindra and there are number of companies, who are all working on electric vehicles of

the current production ranges and because of these various growths, the battery industry lead battery industry is witnessing double digit growths.

(Refer Slide Time: 50:02)

You see here different types of vehicles I was mentioning reva on the top, e scoot and there is again a scooter there and Nano the picture of Nano there, which could be an electric vehicle very soon.

(Refer Slide Time: 50:18)

Now, wind mill energy, solar energy again a lead acid battery has to be there at the base to store the energy and the towers the steel structural, they will be steel, but then they

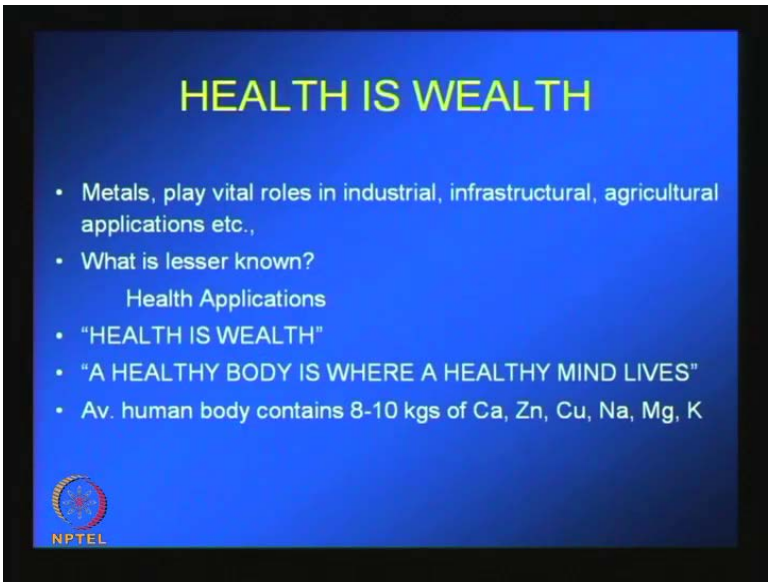
will be coated with zinc. So, zinc would be there, lead would be there and this, where metal is metals are having a very silent role.

(Refer Slide Time: 50:36)

Now, lead and zinc market conditions are very ideal in the country, the markets are growing the economic growth is on a high growth momentum more and more money on infrastructure, more steel being used and increased zinc production in the country and more lead battery recycling will be there in the country. You are going to be producing and using more lead acid batteries. So, after two years, they become a scrap battery, it has to be recycled.

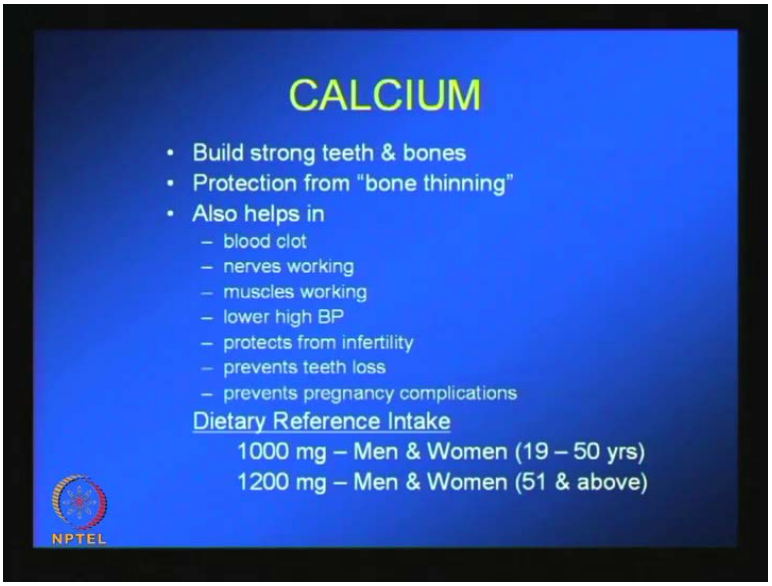
Therefore, that battery recycling will be a growing activity we will have a more and more environment friendly lead recycling in those areas. The domestic demand for both lead and zinc is increasing and the export prospects, whether lead acid battery or galvanized products or dry cells or electric vehicles, the huge export prospects to accelerate we have new market development initiatives, which we should do in this country.

(Refer Slide Time: 51:41)



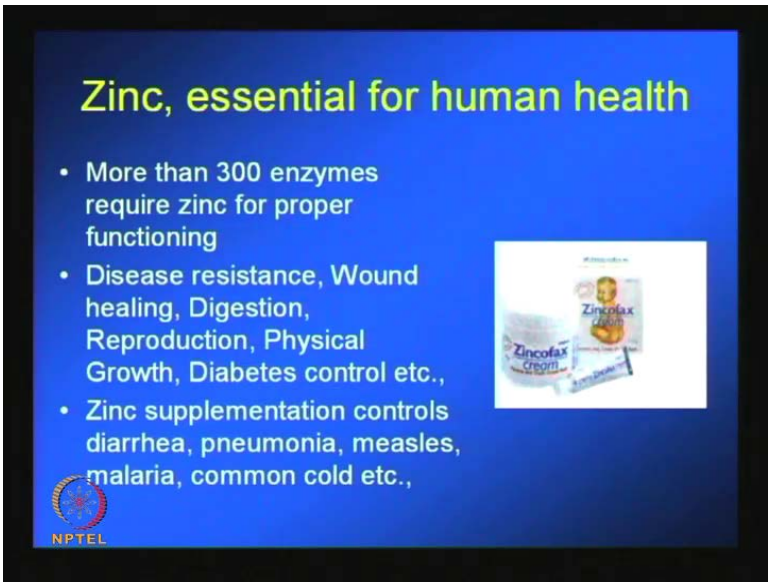
Now, having said so much about industrial applications, now I am going to tell you quickly metals also play a very crucial application in our health, in our wellness this is not known to many people many medicines contain zinc copper etcetera in different forms calcium. Now, health is wealth as I mentioned there and healthy body is where, the healthy mind also lives and an average human body will contain 8 to 10 kgs of all this minerals calcium, zinc, copper, sodium, magnesium, potassium.

(Refer Slide Time: 52:17)



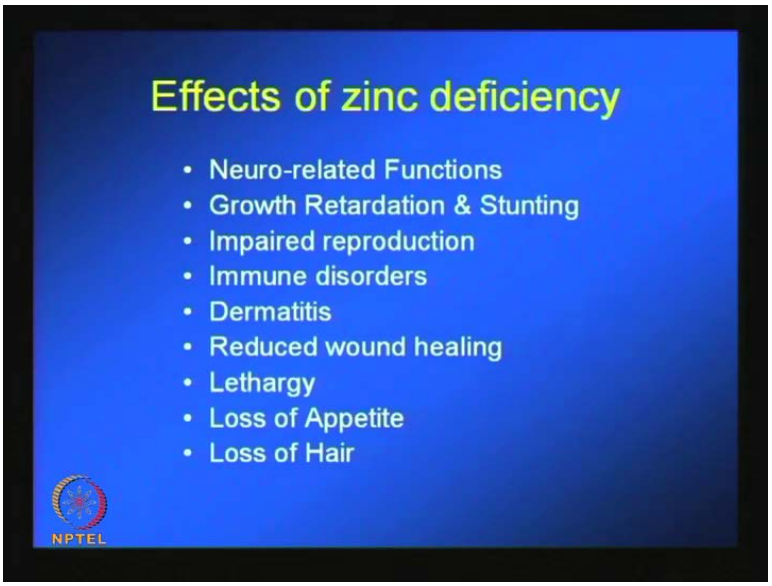
Now, calcium is very essential for your teeth and bones and it has got several important advantages; blood clotting, nerves working, muscles working etcetera and the dietary reference intake for calcium for men and women 1000 milligram for men and women in the age bracket 19 to 50, 1200 mg 1200 mg for men and 51 and above.

(Refer Slide Time: 52:42)



Now, zinc is very essential for human health you see the picture there, zincofax cream and other things and more than 300 enzymes we require zinc for proper functioning. Zinc has got a good disease resistance, wound healing, digestion reproduction, physical growth etcetera. So, zinc supplementation control diarrhea, pneumonia, measles, malaria, common cold and number of advantages of zinc.

(Refer Slide Time: 53:10)



Zinc deficiency will have the following adverse effects; Neuro-related functions, immune disorders, skin related deceases, lethargy, loss of appetite, reduced wound healing, growth retardation all these would happen.

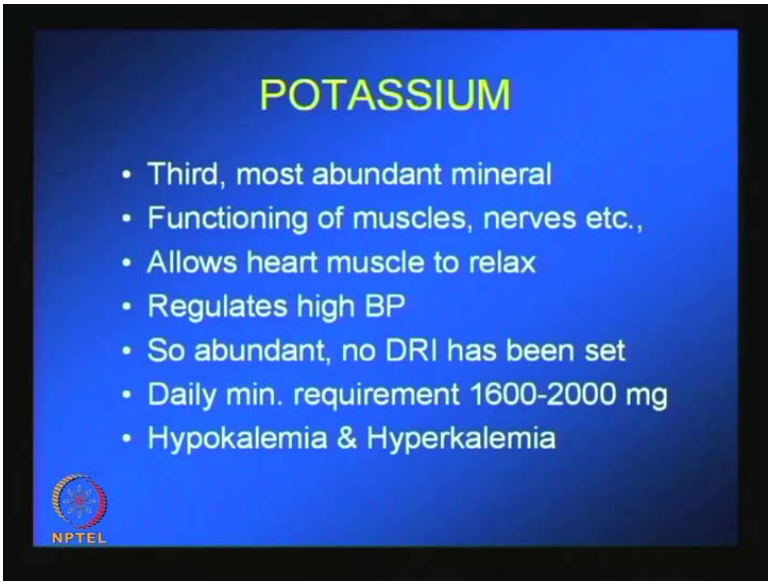
(Refer Slide Time: 53:29)

The recommended daily zinc intake should be this much: infants about 5 milligram per day, children, men, women, pregnant ladies need more, because they need zinc for them and also for the growing baby, the growing fetus in their womb. So, therefore, they need more zinc there.

(Refer Slide Time: 53:48)

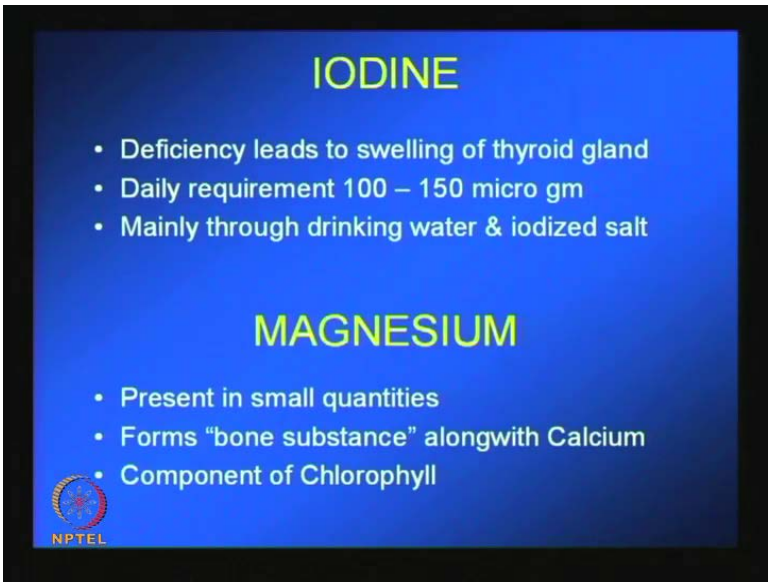
You see here verities of dishes there, they all contain fish, chicken, veg and vegetable they all contained different levels of zinc. The the meats contain more of a zinc not that I am canvassing for this, they have more of zinc, but you can have more of green vegetables to increase your zinc intake.

(Refer Slide Time: 54:11)



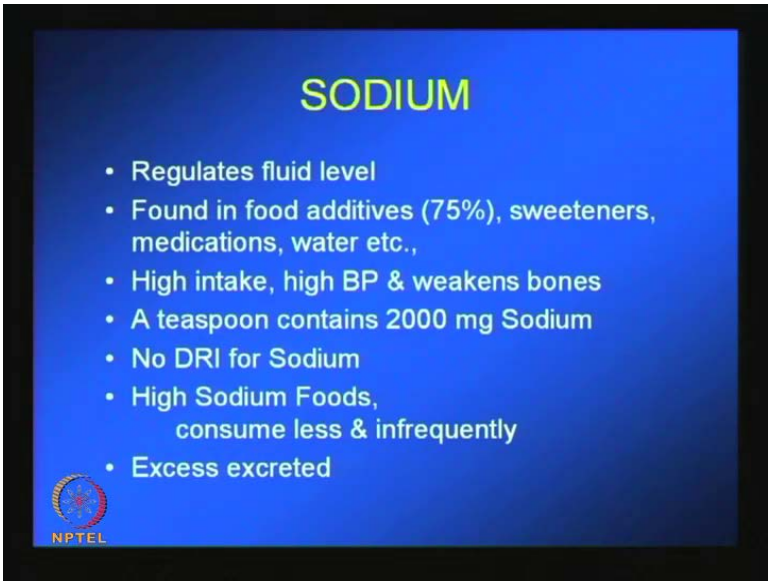
Potassium is very essential again for functioning of muscles, nerves etcetera and it regulates high BP and the daily minimum requirement is 1600 to 2000 mg.

(Refer Slide Time: 54:23)



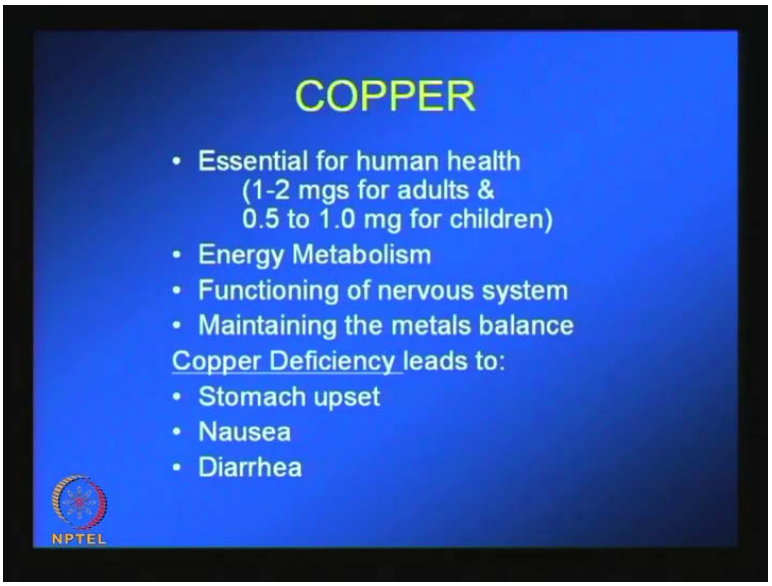
Iodine again very essential come from the water that, you are drinking or from the iodized salt and daily requirement is 100 to 150 micro grams. Now, magnesium they are present in small quantities; it forms a bone substance along with calcium and this is also very essential.

(Refer Slide Time: 54:43)



Sodium it regulates the fluid level in the body and it is also found in food additives, sweeteners etcetera and a teaspoon if you take, it contains about 2000 mg sodium and sodium is very essential for our body any excess goes in the excretions.

(Refer Slide Time: 55:03)



Copper again essential for human health 1 to 2 milligram for adults, 0.5 to 1 milligram for children, energy metabolism, functioning of nervous system, maintaining the metals balance and all this are achieved by copper and any copper deficiency leads to stomach upset, nausea, diarrhea etcetera.

(Refer Slide Time: 55:23)

To conclude, I also mentioned non-ferrous metals play a very very important roles in our society lesser noticed unfortunately, but they play very critical roles in industry, in agriculture, in infrastructure, in health in wellness etcetera. Now, the country is growing

seeing quantum gem growths in non-ferrous metals, high growth industry it is a million ton players coming up here and all of them, they need plenty of young metallurgical engineers, young material scientists for variety of jobs market development technical services for shop floor jobs. So, we need plenty of metallurgical engineers, material scientist and this industry non-ferrous industry, they are all paying attractive compensations now, attractive packages companies like Vedanta companies like Birla, they are all global companies now.

And they need best brains and that can come from our youngsters. And the opportunities that are unfolding in our industry in our research, in our teaching institutes are really huge and India should not suffer from want of human resource for our needs. And and we are poised for quantum gem growth, we should have plenty of young men and women coming forward taking such attractive job, attractive roles exploit India natural resource to the fullest advantage.

And this is where I think I would like all the youngsters every sector is growing, but this sector is also growing and offers enormous opportunities global postings, postings in India, therefore now, would you be interested in case you are interested please consult your seniors in the industry consult bodies like Indians of metals, consult your professors, consult your heads of departments. We would like to council, we would like to guide the youngsters and take good career choices creativity your innovation appetite can be satisfied by going for such kind of jobs.

Computer does not give a long term satisfaction; it is a key board, it is a mouse and there is no creativity and when you are a young, you are looking for so much of challenges, you are looking for achievement in creativity and that, can come by appropriate choices in industry, in teaching, in research etcetera. Thank you very much.