Chemical Technology
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Module - 5
Fermentation
Lecture - 2
Ethenol as Biofuel and Chemical Feed Stock

We are discussing module 5 of the organic chemical technology course and the module as I told you, the module 5 that is having 2 lectures; one was the lecture 1 that was on the Sugar and the alcohol production and the second lecture will be, because I discuss also The importance of the Ethanol; that is not only for the potable purpose about the lot of the industrial application, ethanol is there as a bio fuel and the chemical feed stock. So, we will be discussion in more detail about the use of ethanol as a bio fuel in the chemical feed stock.

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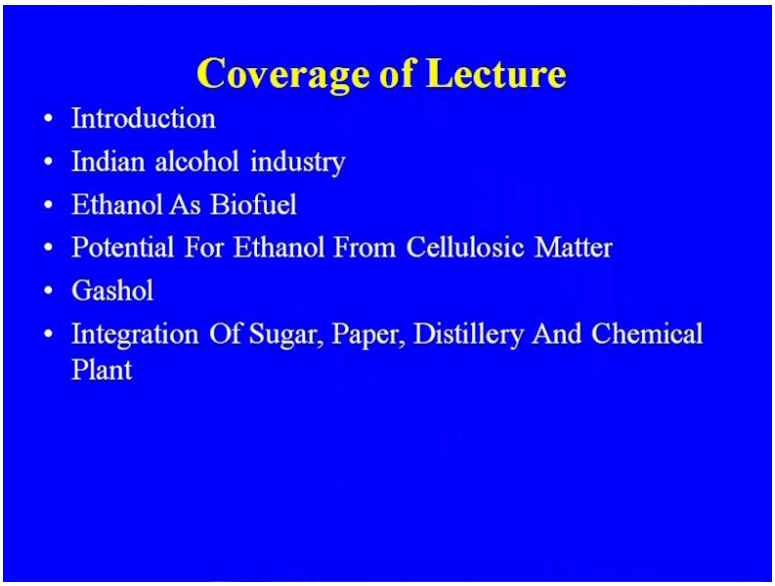

This was the coverage of the lecture introduction Indian alcohol industry, Ethanol as a bio fuel, Potential for ethanol from cellulosic matter, already we discuss some part of this and the biomass. So, the biomass are can we get the alcohol, Gasohol. Integration of the Sugar Paper Distillery and a Chemical plant later with in detail how the various useful material we are producing in the sugar and the distillery which can be utilized for paper making or that can be used for the manufacture of large number of the chemicals.

Although, the chemical industry now usage raw materials based on because this is the organic chemical industry we take the organic chemical industry, we are produced whatever the chemicals now we are producing 90 percent is from the petroleum raw.

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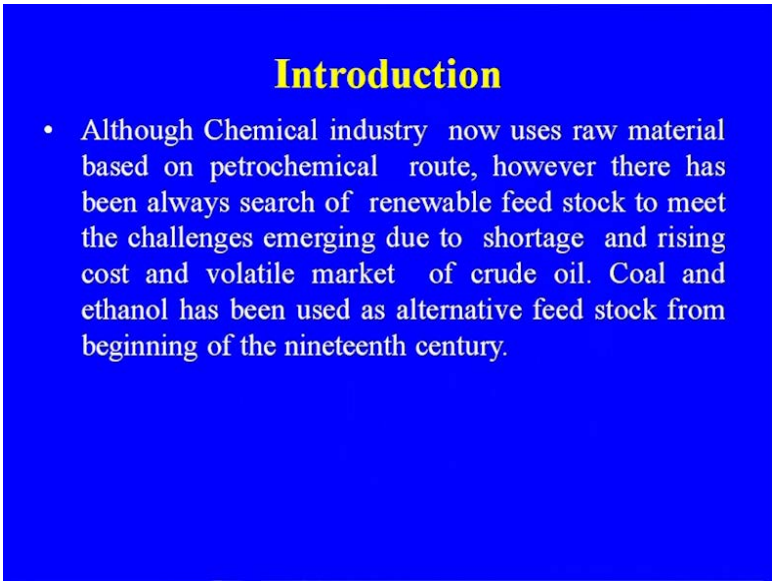

So, the all chemical industry now uses the raw material based on petrochemical route. However, there has been always search of renewable feed stock to meet the challenges emerging due to the shortage and rising cost and volatile market of the crude oil coal and ethanol has been used as a alternative feed stock from beginning of the Nineteenth century and again there had been interest in the coal and the ethanol as a alternative feed stock. Because if ethanol that can be produced from the molasses or the biomass and so, the lot of the worked at as and all the multinationals and in other part of the world, they are more concentrated on the production of the ethanol, then the using use of ethanol as a bio fuel or as a chemical feed stock.

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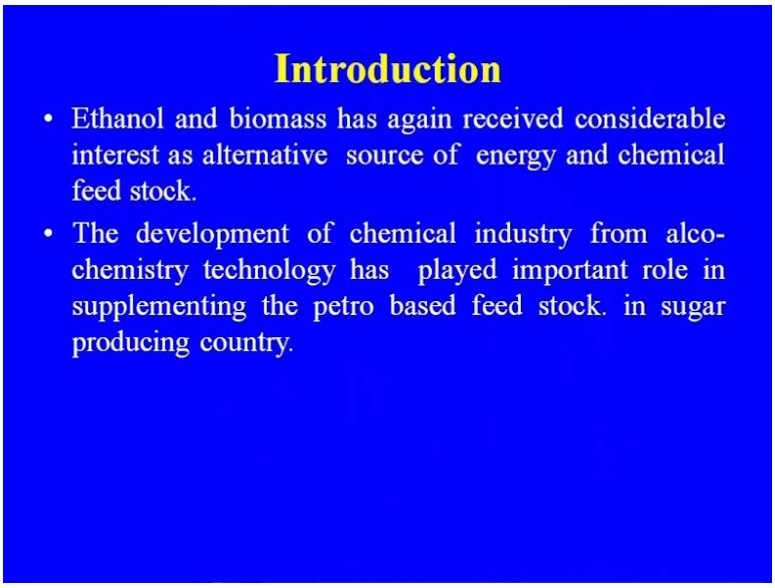

Ethanol and biomass has again received considerable interest as I told you as a alternative source of Energy and chemical feed stock the development of the chemical industry from the Alco-chemistry technology has played important role in the supplementing, the petro based feed stock in sugar producing. Some of the constraints are there, because the cost of production that is high, cost of the molasses, volatile market of the molasses is also creating problem in our country, but in other part of the world just like you take the case of the Brazil, they are going for the some of the polymer plant, producing poly ethanol based on the ethanol.

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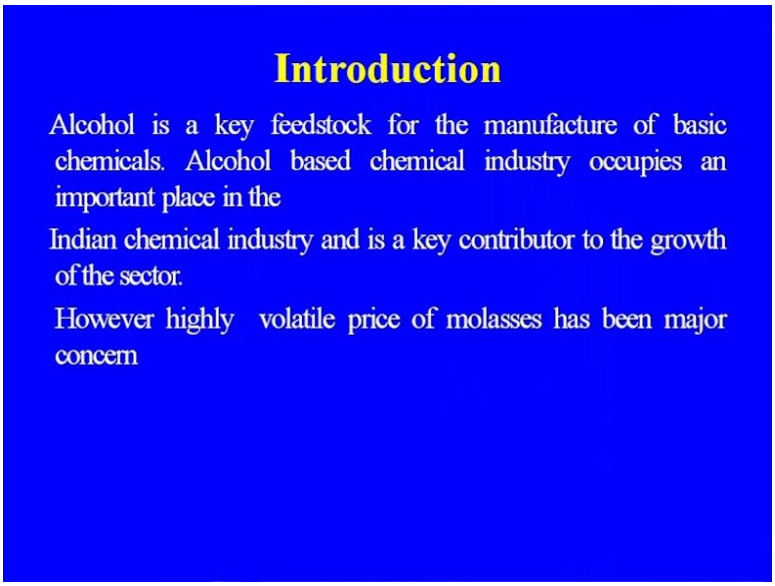

So, the alcohol is a key product for the manufacture of large number of the basic chemicals, alcohol based chemical industry occupies an important place in the Indian chemical industry and as a key contributor to the growth of the sector. However, as I told you the highly volatile price of the molasses has been major concern in utilization of the alcohol from the molasses because that is effecting the total cost economy of the process because we are getting cheaper chemicals through the petro chemical routes, but how long? How long can depend upon, that definitely will have to go to see an alternative feedstock.

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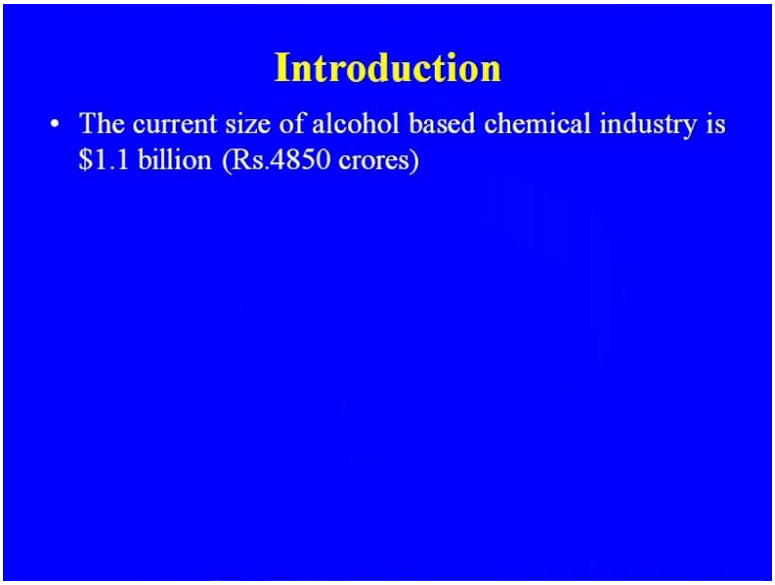

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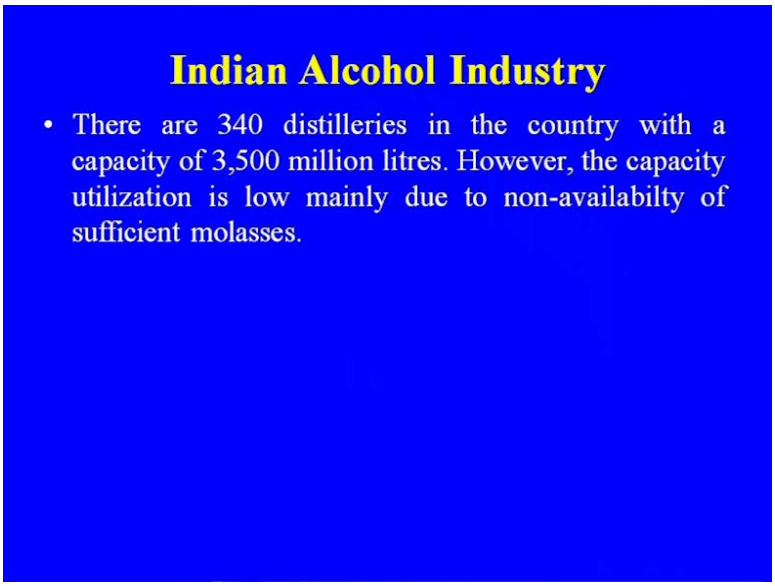

The current size of the alcohol based chemical industry is around 1.1 billion and that is 485 crores. There are 340 distilleries in the country with a capacity of 3500 million liters, however the capacity utilization is low, mainly due to non availability of the sufficient molasses. Because this is also one of the crisis many of the alcohol plant they are facing the availability of the molasses, because there is variation in the supply of the molasses. Because that is as I told you the sugarcane production that is also a seasonal and even the sugar industry they are not running continuous they are for a particular for a season, when the sugarcane is available.

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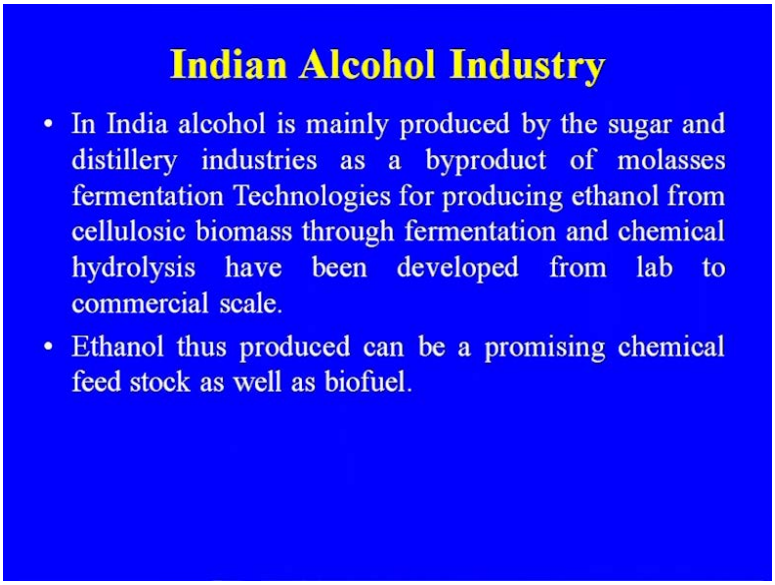

So, in India alcohol is mainly produced by the sugar and distillery industries as a byproduct of the molasses fermentation as I told you, the technology for producing ethanol from cellulosic biomass through fermentation and chemical hydrolysis have been developed from lab to commercial scale. Already we discussed, how we are making the ethanol from the biomass. Ethanol thus produced can be a promising chemical feedstock as well as source of the bio fuel.

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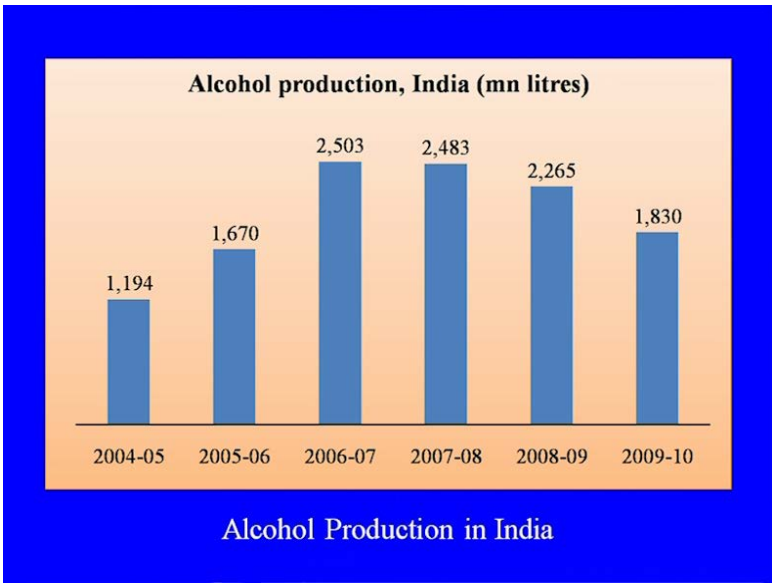

This is the status of the alcohol industry. In India the production of the alcohol and this is the application of the alcohol.

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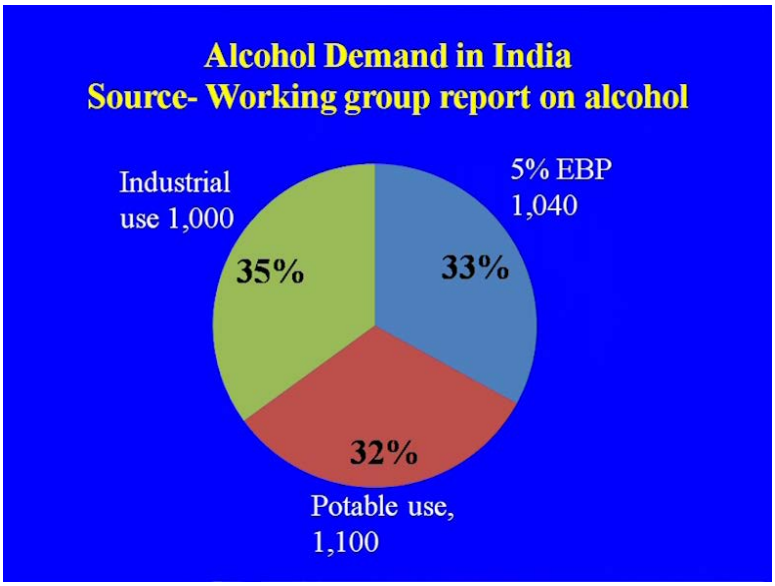

Here the industrial usage that is 10 percent, 5 percent, 35 percent is the industrial application, 33 percent that is in the ethanol bended fuel that is where the bio fuel; that is we are using and 32 percent is the potable purpose.

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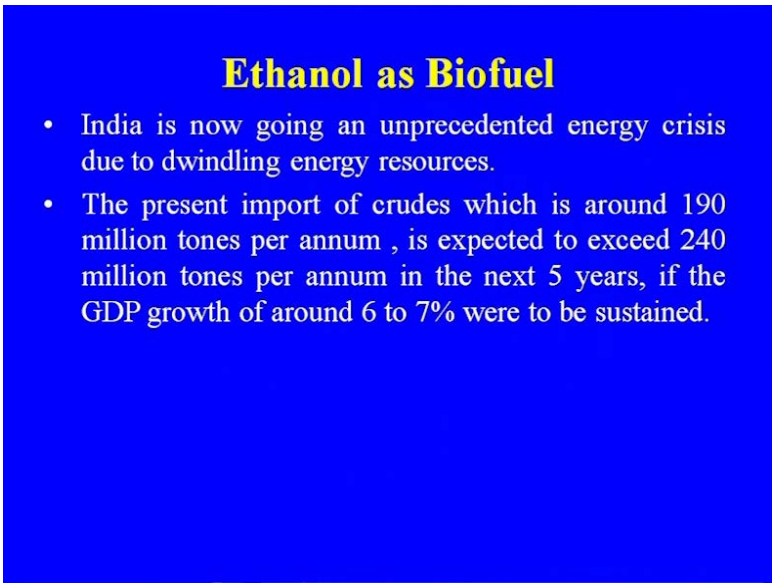

Globally bio fuels developments are primarily driven by three fundamental policy consideration; rural development, energy independence and reduced carbon footprint, because the bio fuel we can use the 5 to 10 percent of the ethanol, because they you see the this is the oxygenate. Ethanol as a bio fuel alcohol has been globally accepted as an alternative to gasoline and alcohol blend. Gasoline are being used in many countries in varying proportion ranging from 5 to 20 percent as ethanol. India is now going an unprecedented energy crisis due to dwindling energy resources and the volatile market of the crude oil the present import of the crude, which is around more than 190 million tons per annum is expected to exceed 240 million tons per annum in the next 5 years, if the GDP growth of the around 6 to 8, 6 to 7 percent were to be sustained. So, the number of refinery all the refinery most of the refinery they have been increased their capacity. So, they even we are not available to meet the requirement.

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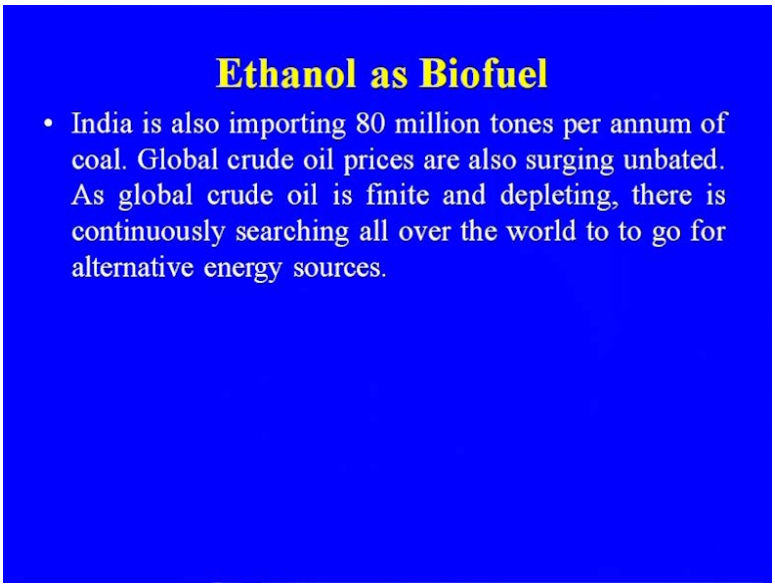

India is also importing 80 million tons per annum of the coal, global crude oil prices are also surging un bated because why I am given this figure of the coal, because still will have to see the alternative sources. As a global crude oil is finite and depleting there is continuously search for alternative energy resources. All over the world people are working, how to go for the… Now, they are going for the, they are going for the sand oil, all those thing are only because just utilized whatever the resources that is available to make the fuel.

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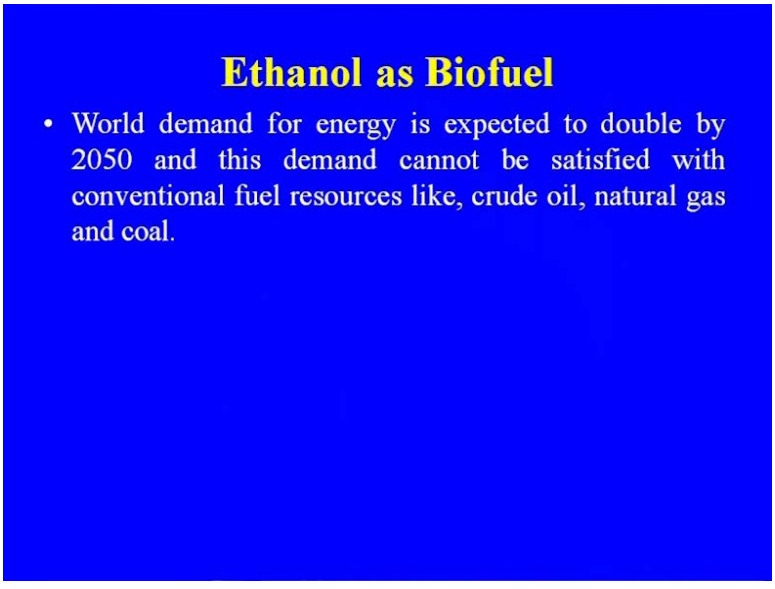

So, for the energy consumption is concerned, the world demand for the energy is Expected to double by 2050 and this demand cannot be satisfied with the conventional fuel resources like crude oil, natural gas coal, so we will have to think of the alternative source of energy although the nuclear power plants are coming, but still the utilization of the whatever the nuclear far way of producing it is too much less.

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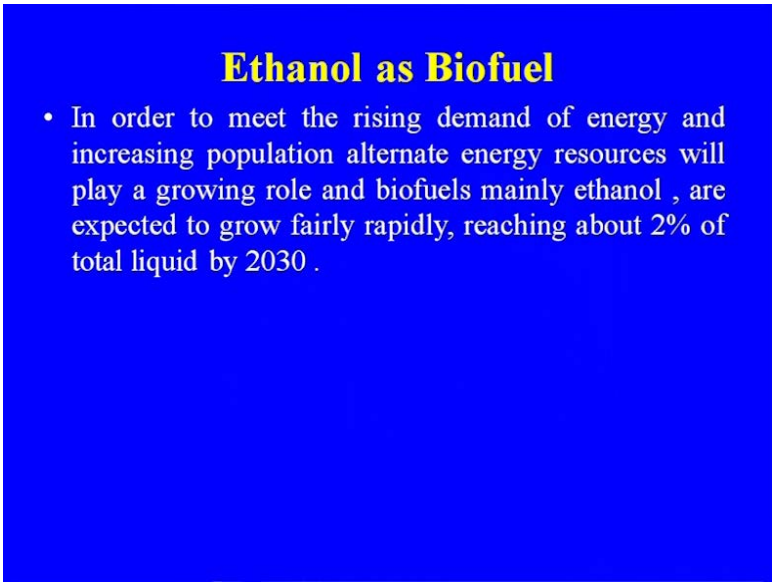

In order to meet the rising demand of energy and increasing population because the now we are having around 7 billion population. In India we are having 1.2 billion population, so from where the resources will come? Alternative resources we are exploiting, the alternative energy resources play a growing role and bio fuels mainly ethanol are expected to grow fairly rapidly reaching about 2 percent of the total liquid by 2030, because ethanol that is a source that is a product we are getting found the molasses root from the sugar cane. So, that has become very important especially the countries, which are producing ethanol as sugar.

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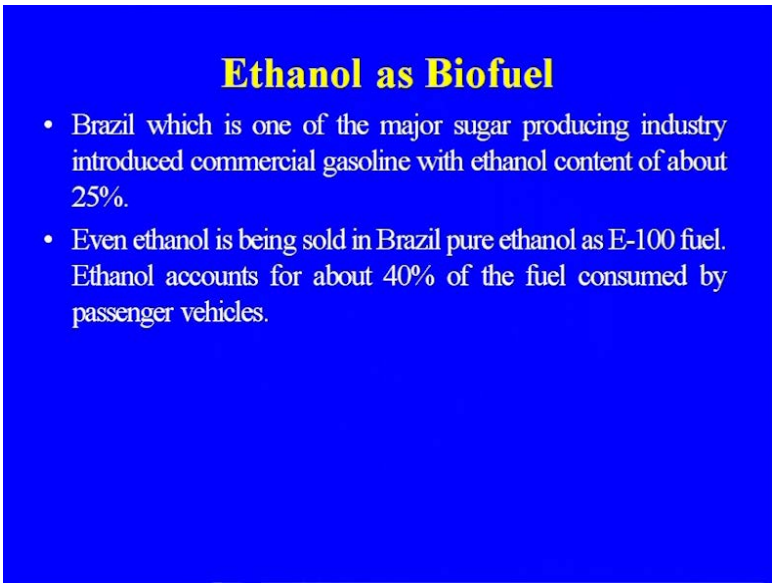

Brazil as I told you is one of the major sugar producing industry they introduce commercial gasoline with ethanol content of about 25 percent. Even ethanol is being sold in Brazil pure ethanol as E 10, E 100 fuel means the 100 percent ethanol base, but that is separately you will have to modify the engine also. Ethanol account for about 40 percent of the fuel consumed by passenger vehicles in Brazil.

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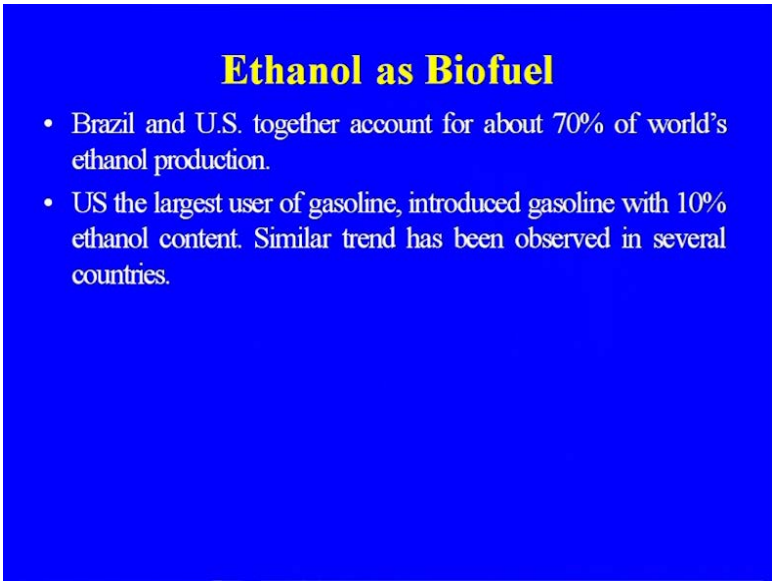

Brazil and US together account for about 70 percent of the world ethanol production. US the largest user of the gasoline and introduce gasoline with 10 percent ethanol content. Similarly, similar trend has been observed in the several other countries where the ethanol they are making from the molasses rule.

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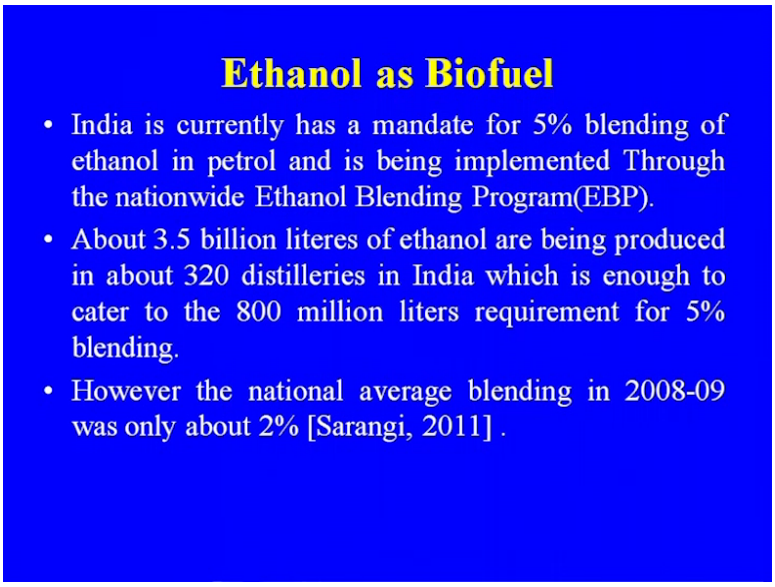

India has mandatory for 5 percent blending of the ethanol in petrol and is being implemented throughout the nation wide ethanol blending program EBP, which I show the consumption 5 percent that is through the nationwide ethanol blending program about 3.5 billion liters of ethanol are being produced in. About 320 distilleries in India, which is enough to cater to the 800 million liters requirement for 5 percent blending that is the constant because you cannot increase, even if you are going behind 10 percent. Then definitely there are some other problems also apart from the availability of the alcohol. However, the national average blending in 2008 to 9 was only about 2 percent because rest of the alcohol that was being utilized for other purpose. So, that is very important, if you are going to use the ethanol as a wide fuel. So, the availability of the ethanol at the cheaper because the cost of the ethanol that is definitely slightly have… If you are blending than that may increase the cost that is one term we are using the gashol.

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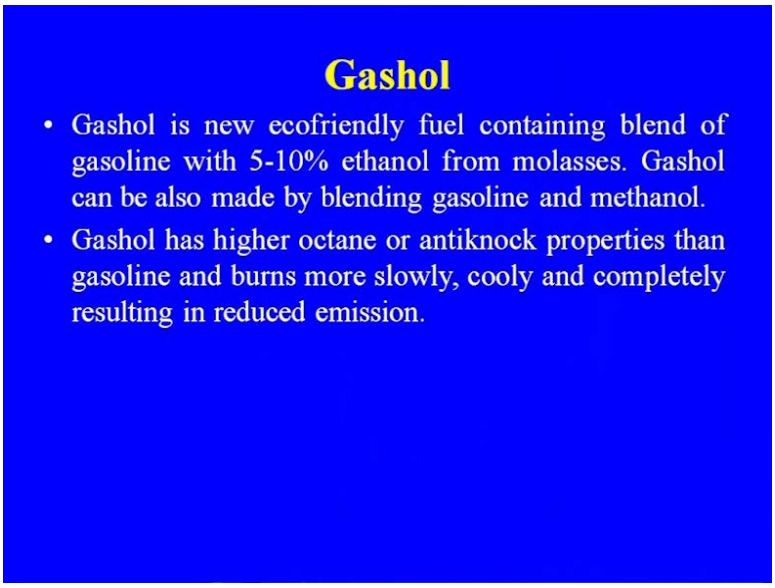

Gashol is the new eco friendly fuel containing blend of gasoline with 5 to 10 percent ethanol from molasses. Gashol can be also made by blending gasoline and methanol because the another product that is very important that is methanol that is also oxidant, but there was some problem in the initial stage when the MTBE won a product that we are getting problem methanol, I will be telling something about the various oxygenates that we are using. So, the gashol has higher octane or antiknock properties than the gasoline and burns more slowly, coolly and they completely resulting in the reduced emission; so that is the advantage in many of the oxygenates we are using.

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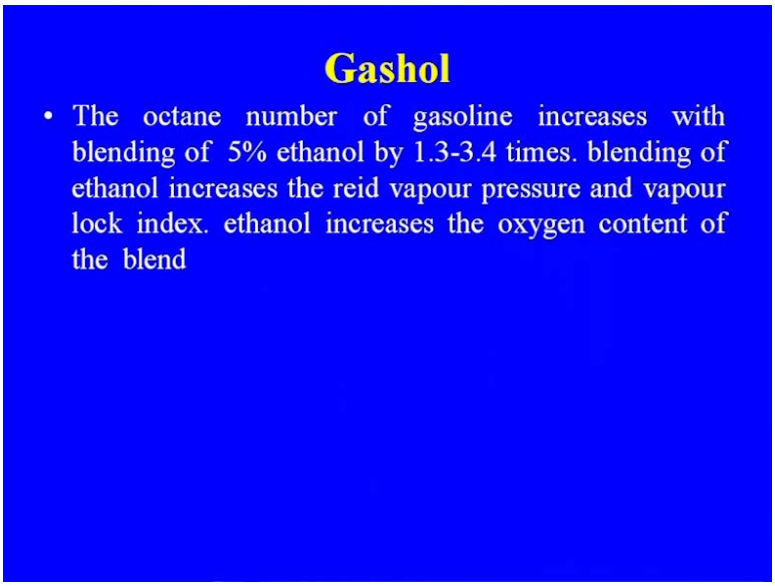

The octane number of the gasoline increases with the blending of 5 percent ethanol by 1.3 to 3.4 times. Blending of the ethanol increases the reid vapour pressure and vapour lock index ethanol increases the oxygen content of the blend.

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Oxygenates Permissible in India
Source[Biofuel 2003]

Oxygenate	Permissib;e Limit (V/V) .Max
Methanol	3.0
Ethanol	5.0
Isopropyl alcohol	5.0
Teriary Butyl Alcohol	7.0
Ehters Containing five or more carbon atoms	15.0
Other oxygenates (acetone)is not Permitted	7.0

Because different oxygen oxygenates which we are using it may be ethanol, it may be methanol as various ethers are there. So, oxygen content that is vary this is the some of oxygenates their boiling point blending point average octane oxygen content and blending limit that is reported MTBE ETBE that is methyl tert-butyl-ether, ethyl tert-butyl-ether and the TAME because these two products MTBE and TAME. That is being weight by using the C 4 C 5 gaseous from the FCC. So, that is one of the major source of the MTBE and TAME, but the as I told you the ethanol blending of the ethanol and the replacement of the MTBE.

That was not well taken because in case of the MTBE it was reported that MTBE is a highly your from the carcinogenic. So, there was problem in US, so they banded use of the MTBE. In case of the MTBE huge amount of the methanol that we are using, so for the time is concerned in Jamnagar refinery, we are using we are making the TAME MTBE that has been made by the internal composition Vadodara unit. These are the two important actually the oxygenate boiling point another details are given here alcohols amongst the alcohols methanol and ethanol that can be blended methanol that can be blended.

But the here if you see the temperature boiling point and that there is difference in the average octane number. Methanol that is prior to ethanol, but again, because they normally what about the methanol we are what we seeing that is through the synthesis gas rule. But as I told you while discussing the raw material in the feature lot of the work that is from the coal to methanol or the biomass to methanol, some plants are also coming and so they definitely be methanol. That will be more cost saving or the alternative source that may be there and this is about the ethanol and blend of GT.

So, this is various type of the oxygenates these are called the oxygenate so oxygen definitely has a some of the property better than the other, but not if you compared with the methanol definitely the average octane number that is the research octane number and the octane number. So, average that is add incase of the methanol. Now, let us discuss that was about the one of the problem that we are facing in utilization of the methanol; that is the availability of the ethanol because the other usage of the ethanol.

The product which you are getting especially for the particular purpose or the as a chemical feed stock, definitely that is more economical and the economic part. That is playing important role and the major come and the at the same time availability of the continuous availability of the alcohol for the gasoline blending in the blending of the alcohol with the gasoline ETBE. So, that is the actually the problem in case of the ethanol but, ethanol as a chemical feed stock let us discuss in slightly more details.

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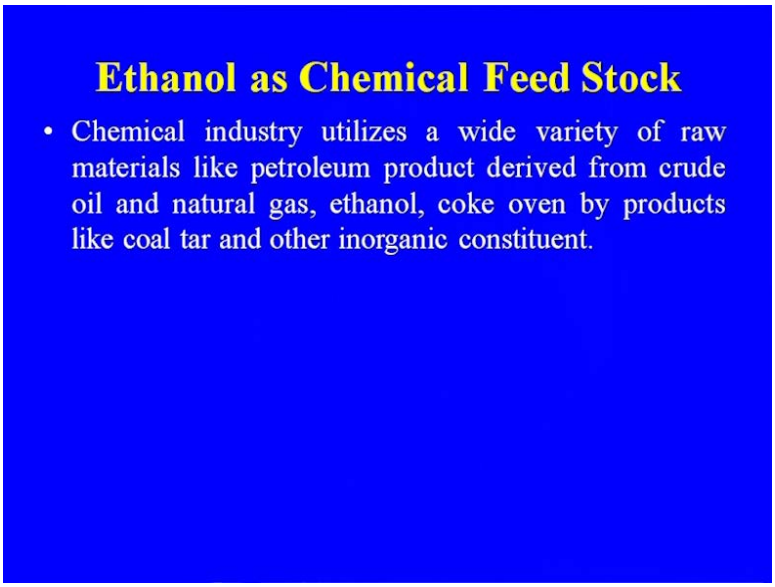

I already told you in the lecture 1 about the importance of the ethanol. In the chemical industry chemical industry utilizes a wide variety of the raw materials like petroleum product derived from crude oil and natural gas ethanol coke oven byproducts like coal, tar and other inorganic constituent through the calcium carbide, these are the some of the actually the raw material, which is available. As I told you the 90 percent of the total chemical, organic chemical that we are producing through the petroleum route only the because the coke oven plant that is byproducts. So, utilize it so only the smaller position of the total requirement that of the feed stock for the organic chemical industries through the coke oven plant.

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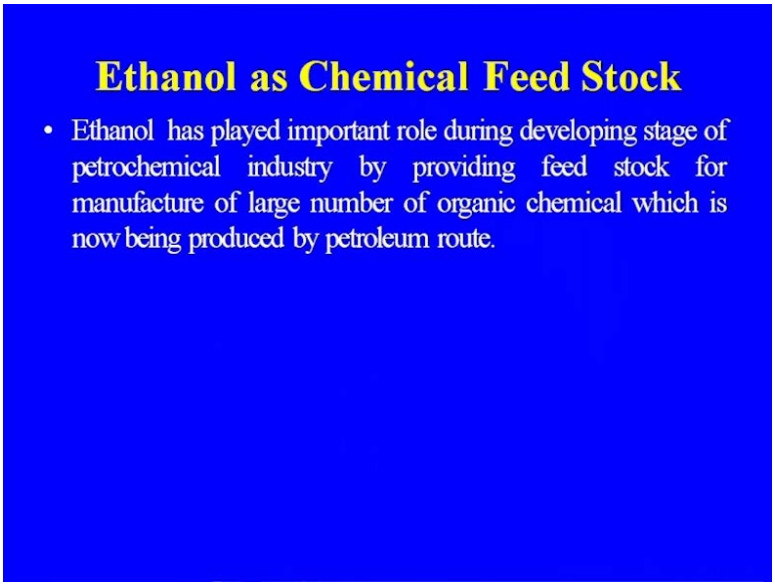

Ethanol has played important role during the developing stage of petrochemical industry by providing feed stock for manufacture large number of organic chemical, which is now being produced by petroleum route. Because you see the during the 1950s if so for India is concerned, we got the independence in 1946 and the period 1940s saving to 1960 that was the year of the industrializing. Even we are not having any petro chemical complexion, so at that time the source of the some of the raw material for chemical industry that was the ethanol because the sugar industry very old in India.

So, the even the fermentation industry, production of the alcohol that was starting long back before coming of the better chemical industry, so the ethanol that was they consider

as a promising feed stock for making large number of the petro. Even if you see the some of the pure chemical plant based on totally ethanol that was started one of the plant that is at the ISRA by us ISI with a very small capacity on they started that for the production of ethylene from ethanol.

Similarly, synthetic chemicals and Bareily, they started making SBR styrene-butadiene rubber, there are using the ethylene produced from the ethanol and the Indian glycol and jubilant organosys. This was I told they are the two major Indian glycol and the jubilant organizes and the maya chemicals. It was also there, but now they have been stop there plant at Barabanki.

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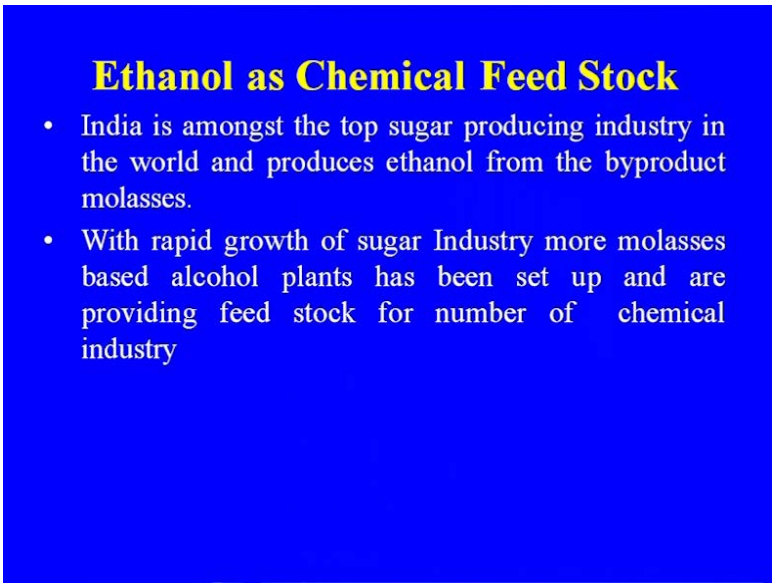

So, as I told you the lecture 1, that India is amongst the top sugar producing country in the world and produces ethanol from the byproduct of the molasses. With the rapid growth of the sugar industry more molasses based alcohol plants has been set up and are providing feed stock for number of the chemical industry.

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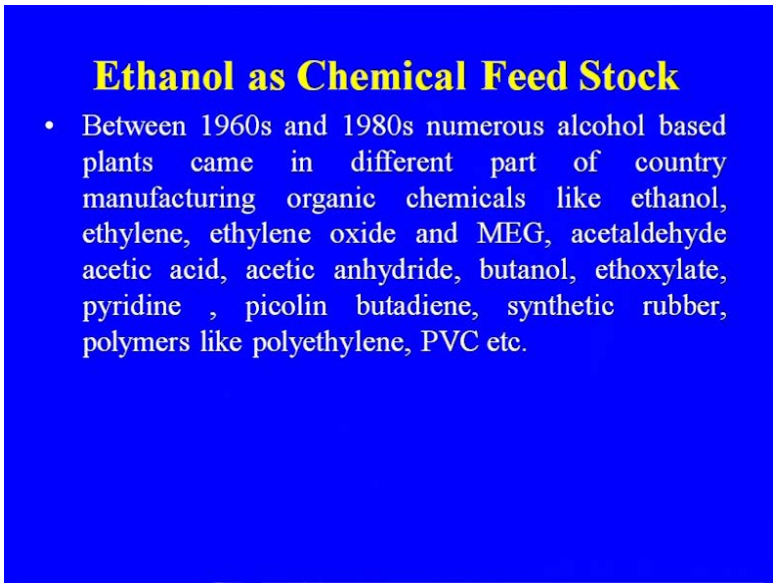

Between 1960s and 80s numerous alcohol based plants came in different part of the country manufacturing the organic chemicals like ethanol, ethylene, ethyleneoxide, MEG, DEG, TEG, STDLI, acetic acid, acetic anhydride, butanol, ethoxylate, pyridine, picolin butadience, synthetic rubber, polymers like polyethylene PVC. Because the in case of the PVC or polyethylene we are using the ethylene and that ethylene can be made available from the ethanol. So, I told you that the some of the major player, which we are using the alcohol as a raw material at the Indian.

Glycol where they are making ethanol ethylene ethyleneoxide MEG, TEG, DEG, mono ethanol glycol MEG and so they are also making the ethoxylate. VAM organic now jubilant organosys, they are making a large amount. That is one of the actually we can say large integrated chemical complex base totally based on the molasses, they are having the alcohol plant where they are producing the alcohol and that alcohol they are using for the production ethylene. From the ethylene a large number of the chemical they are producing. So, maya chemicals again that was in Barabanki, so they are producing. Apart from the there are other number of the chemical factories are using the alcohol based ethylene just like synthetic chemicals about Bareily, now it is closed.

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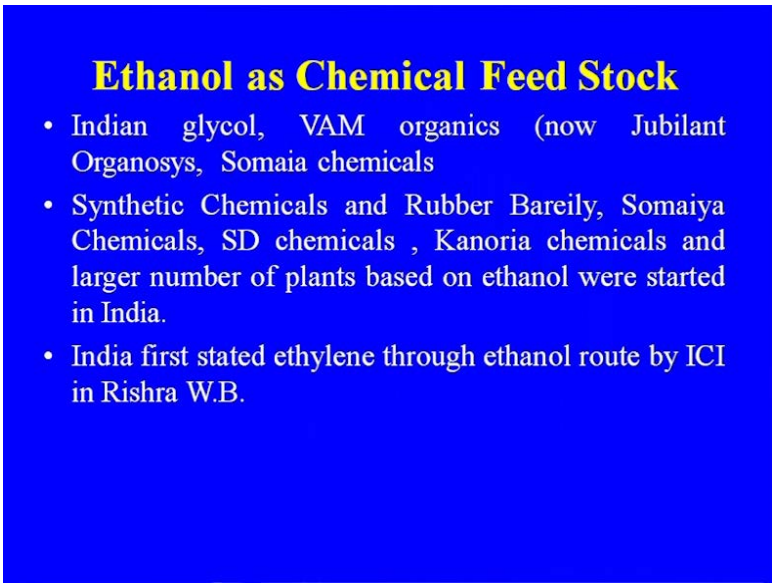

Earlier, earlier it was making the, that was the first plant base on the molasses route for making of the synthetic rubber in India. SD chemicals, Kanoria chemicals and large number of plants based on the ethanol were started during the that period when the number of the sugar plant increase. India first is started ethylene through ethanol route by ICI in Rishra West Bengal.

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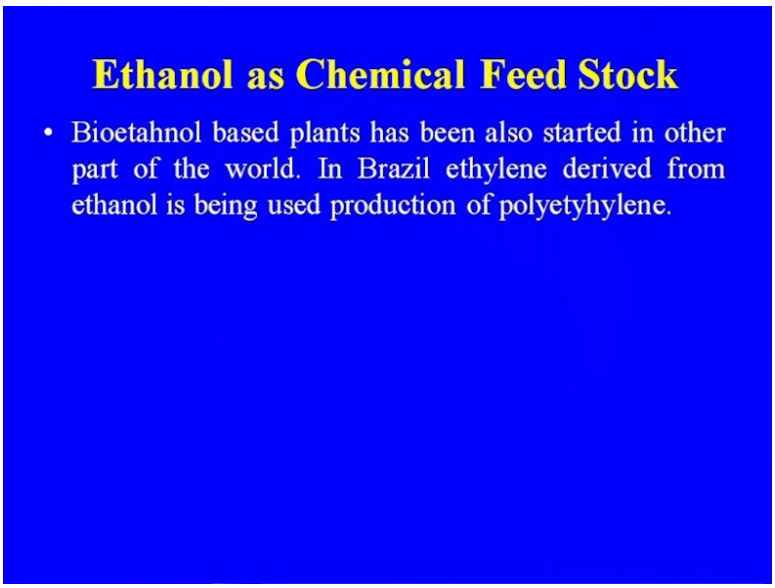

Why ethanol based plants has been also started in other part of the world? In brazil ethylene derived from ethanol is being used for the production of the polyethylene, totally based on the molasses route or the alcohol from the molasses.

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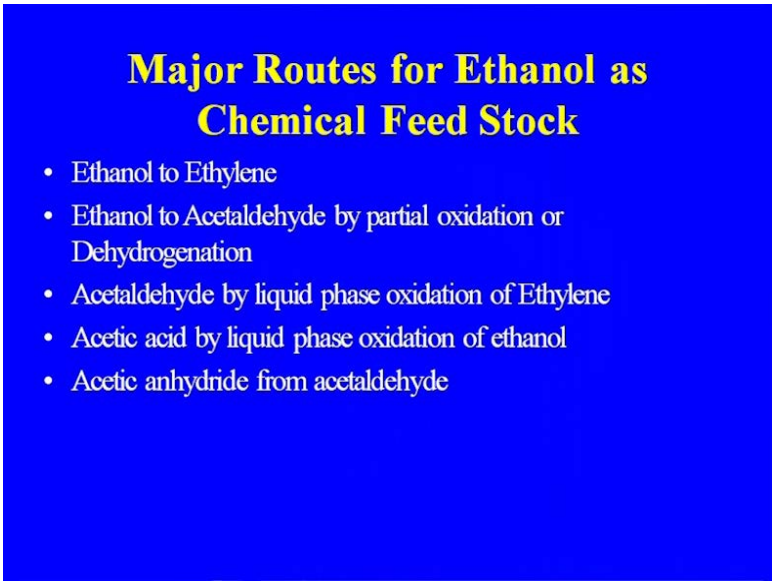

Major routes for ethanol as a chemical feed stock because ethanol to ethylene because how we are making, what are the product that you can… A long list of the chemicals are there which we are making first major part of is started in case of this Indian glycol or bio-organic. That was the conversion of ethanol to ethylene because vice versa. We can produce ethylene to ethanol also that is through the petro chemical route, but most of the you are now the because large capacity naphtha taken as common we are producing lot of the ethylene from the cracker plant.

But earlier route was before coming of the your this crackered; that was the ethanol route, so ethanol to ethylene ethanol to acetaldehyde by partial oxidation or the dehydrogenation. This was the process of making and the bio organic. They are making the acetaldehyde from this route acetaldehyde by liquid phase oxidation of ethylene acetic acid, by liquid phase oxidation of ethanol acetic anhydride from the acetaldehyde route and this acetaldehyde again from the ethanol produce from the molasses.

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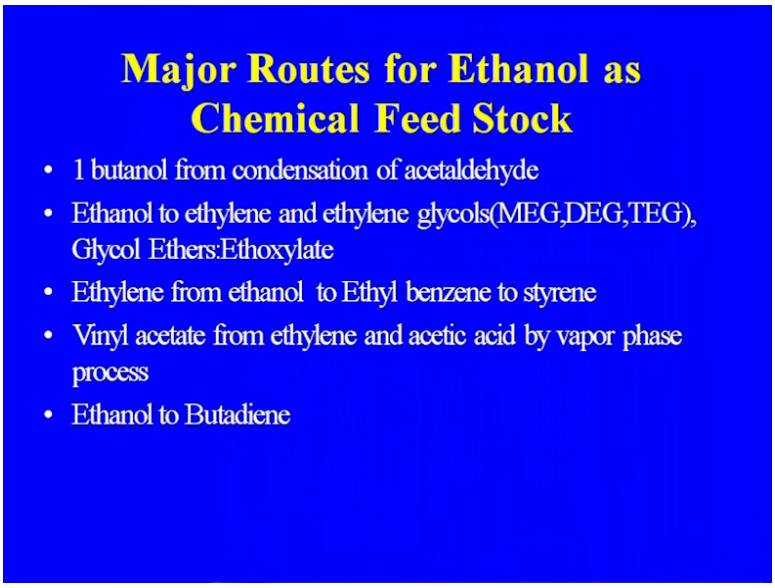

1 butanol from condensation of acetaldehyde, again acetaldehyde the same route ethanol to ethylene and ethylene glycols MEG, DEG, TEG, glycol ethers, ethoxylate. Ethylene from ethanol to ethyl benzene and then converted to styrene. This was the how the ethylene that was used, used in synthetic and chemical Bareily for producing the SPR.

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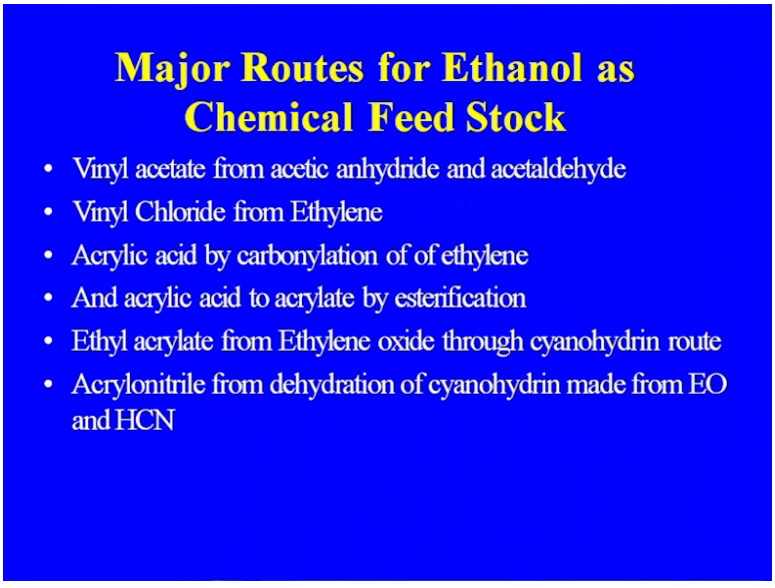

Vinyl acetate from the ethylene and acetic acid by vapor phase process, ethanol to butadiene, vinyl acetate from acetic anhydride and acetaldehyde vinyl chloride from ethylene, ethylene again from the alcohol route. Because now the all the vinyl chloride

except one plant at chemicals, which they are making the vinyl chloride from calcium carbiode route all the plants are based on the ethylene from the cracker. But that can be a source for the making of the vinyl alkaloid, only constant that tells me the cost of production of the ethylene which you are getting from the alcohol route that is higher than the what you are getting from the cracker plant.

Then the other important product that can be made acrylic acid by carbonylation of the ethylene and the acrylic acid to acrylate by esterification. Ethyl acrylate from ethylene oxide through cyanohydrin route acrylonitrilite from because acrylonitrilite again that is one of the very important product for making of the acrylic fiber, which we are making through the arrange a petro chemical from the propylene. But that route is available, this is the beauty of the nature they have provided a large number of the alternative raw material resources for us. Only thing that how best we are utilizing, so acrylonitrile from dehydration of this cyanohydrin made from the EO and the hydro cyanide.

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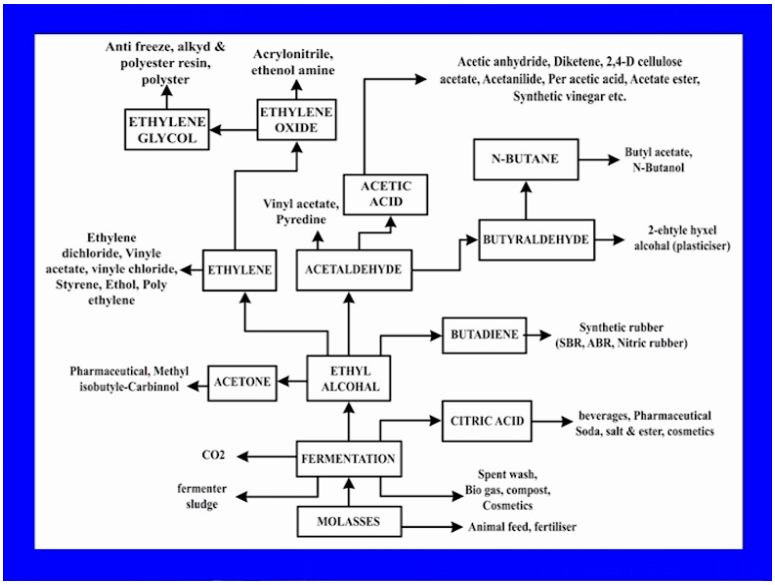

This is the product profile of ethanol and how they this is the some of the plants they are making just like I told you the jubilant organosys or which may be it was the somaya organics or even in case of the Indian glycol, this is the molasses. After the fermentation you are getting the ethanol, this ethanol that have been converted to acetone. They are that is being used large application of the acetone is there. Ethyl alcohol that have been

converted to butadiene, which is being used for the making of the and this was the actually how the styrene input of the inter word plant that was started at Bareily.

Then ethyl alcohol to ethanol as that both the roots are there; you can produce ethyl alcohol to ethanol or ethylene to ethanol. So, the root is available only if you are coming from ethylene to ethyl alcohol, then that will have to go for the petro chemical. So, ethylene this ethylene that that can be very large number of the product, which you are getting which you are making from the ethylene. So, the chemical petro chemical routes and this already I discuss some of the products, which are getting from the ethylene. One of the very important product from the ethylene that is the ethylene oxide or the ethylene glycol.

Ethylene glycol means both the mono di and tri ethylene glycol and these products are finding wide application, in case of the entropy, alkyl regions or the even the Polyester MEG. MEG huge amount of the MEG that is being used in the manufacture of the polyester during the polymerization deduction of the terry ethylic is with fringe like. So, ethylene oxide that is one of the very important product, then the another product which we are getting acetic acid and that acetic acid again that can be used for making of the number of the products also.

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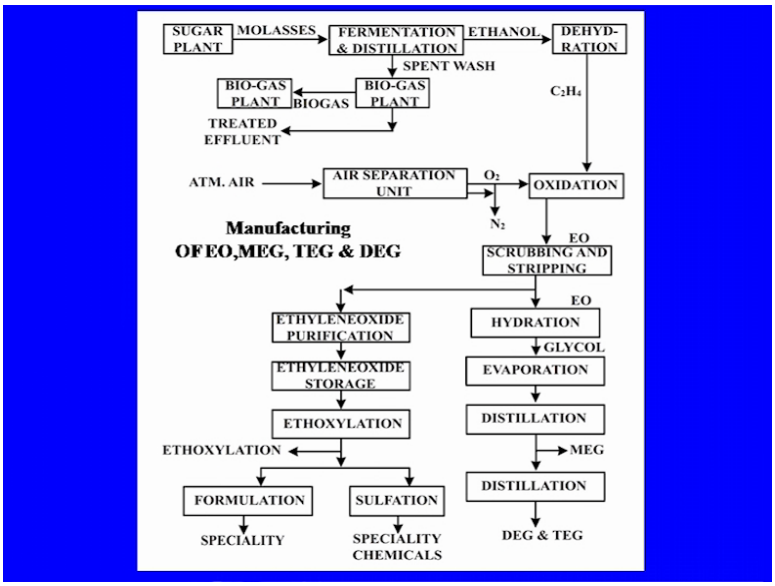

Then the butaldehyde from the acetaldehyde that you can make and then and that will be ethyl 2 ethyl alcohol that can be there, so which is being used in case of the plasticizer.

So, this is the actually the ethanol tree you can say from where you are making a large number of the your chemical, which are now most of the cases now the what we are doing we are having the ethylene and from ethylene all these products that can be made.

This is the process that is being used in case of the when your because you need the oxygen for oxidation of the ethylene and here accurate is shown that the sugar plant molasses fermentation biogas plant. Because the spend was which you are getting that is going to the biogas plant, where we are generating the biogas and again that is being using the plant. The alcohol ethanol dehydration then ethylene and then the ethylene by oxidation of ethylene we are getting large number of the product starting from ethylene oxide ethylene alcohol Meg, DEG DEG, which I told you that we are getting because during the hydrolysis of the ethylene oxide all the Meg, DEG or TEG are formed. So, that can be actually can control the formation of the your all this MEG will be controlling the water and during the hydrolysis.

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Sr. No.	Alco-chemical	Downstream Product	Major application of downstream product
A.Plastics, Resins, Elastomers			
1	Styrene	ABS Resins	ABS Products
2	Styrene	SAN Resins	SAN Products
3	Styrene	Ion-Exchange Resins	Water Treatment, Effluent Treatment.
4	Ethylene	LDPE	LDPE Products

Sources: Ashok 2000,

These are the some of the products alco-chemical products, which we are getting and their application styrene and styrene ABS resin san ion-exchange resins LDPE ethylene that you can use and these are the major application down the stream. Application of this bi-level product it will be ethylene to the styrene what we need we need the ethyl benzene and for the ethyl benzene what we need benzene and ethylene. So, styrene can

be also meet through this route using the ethylene from the this is what the synthetic and chemical Bareily plants with a resin.

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Sr. No.	Alco-chemical	Downstream Product	Major application of downstream product
A.Plastics, Resins, Elastomers			
5	MEG	Polyester Films	Packaging
6	Vinyl Acetate	EVA/VAE Polymer	
7	Styrene	SBR	Tyres, Footwears, Belts and Rubber Goods.
8	Acetic Anhydride/Acid	Cellulose Acetate	Bangles, Films, Spectacle Frames.

Sources: Ashok 2000,

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9	Styrene	Poly-Styrene	PS Products
10	Styrene	PS Foam	Packaging
11	Vinyl Acetate	Emulsions	Adhesives
B. Chemicals			
12	Styrene	Styrenated Phenol	Rubber Chemical
13	Acetic Acid	PTA	Polyester Feedstock

Sources: Ashok 2000,

Another already I have I discussed the MEG, vinyl acetate, these are the application of the various product that we are getting from the, because the bio-organic why the name came the vinyl acetate monomer that was, so they kept the name the vinyl acetate for making the poly vinyl acetate. So, there was the, a major product of the jubilant organizes. These are the some of the application SBR, acetic anhydride, when we are

making the synthetic fiber, cellulose acetate they are using the acetic anhydride. Other application are also there. Then the again styrene, acetic acid, acetic anhydride various products we are getting from there. So, they are finding use for the solvent for ethylic fiber.

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14	Acetic Acid	Di-methyl-Acetamide	Solvent for Acrylic Fibre Industry
15	Acetic Acid	Aceto Acetates	Pharmaceutical & Pesticide Intermediate
16	Acetic Acid	Aceto Acetanilide	Dyestuff Intermediate
17	Acetic Acid	Aceto Acetanides	
18	Acetic Anhydride	Paracetamol	Pharmaceuticals
19	Acetic Anhydride	Aspirin	- do -

Sources: Ashok 2000,

Di-methyl acetamide now we are making with the di-methyl pharma-meter, di-methyl acetamide through the synthesis gas rule. But from the acidic acid also we can make the di-methyl acetamide.

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20	Acetaldehyde	Vinyl Sulphone	Dyestuff Intermediate
21	Acetic Anhydride	Acetanilide	Dyestuff Intermediate
22	Pentaerithritol	Emulsions/Dispersions	Paint Industry
23	Pentaerithritol	PETN	Explosives Industry
24	Glyoxal	Pharma	Drugs & Pharmaceutical
25	Glyoxal		Textiles

Sources: Ashok 2000,

Then the acetaldehyde again acetic anhydride pentaerithritol that we are using in the paint industry and this is also used in the explosive region that is the explosive industry, which I will because there this is the through the ethylene oxide, glyoxal, the pharmaceutical industry.

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26	Monochloro-Acetic Acid		
27	Ethyl Acrylate	Emulsions/Dispersions	Paint Industry
28	Ethyl Vanilin	Flavouring-Formulations	Food Processing Industry
29	DDT	Formulations	Pesticide
30	2,4-D	Formulations	Pesticide
31	Ethylene Oxide	Condensates	Various Industries

Sources: Ashok 2000,

Then the other there is a number of the products are there where we are using in some or other form the ethanol, ethylene and their derivatives.

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B. SYNTHETIC FIBRES

2	MEG	Polyester Fibres	Textiles, Tyre Cord/ Yarn, Industrial Yarn
3	Chloro Acetic Acid	CMC	
4	Acetic Acid/ Anhydride	Vinyl Acetate	Adhesives/Polyms
5	Acetanilide	Sulpha Drugs	Drugs & Pharmaceuticals
6	Acetanilide	Intermediate	Dyestuffs

Sources: Ashok 2000,

So, chloro acetic MEG that I told you the use for the polyester acetanilide, acetanilide etcetera. Now, let us discuss one of the very important part in case of the to improve the economy of the sugar mill, we can integrate this sugar paper distillery and a chemical part and definitely there is going to improve the overall economy of the sugar plant. But only thing that is the location because RDI some means are not have been there in the distillery paper mill or other side.

So, normally they are transporting the bagasse from sugar mill to other places where they are making the paper. Similarly, the molasses that is being transferred from sugar mill to the some of the distillery, where they are producing. These are the some of the actually the what definitely they some of the product, which we discuss either it is a bio fuel or making a large number of the chemical or the bagasse as a paper, the raw material for paper making while discussing the paper making, we discuss. So, the 100 percent bagasse base plants are very which are using the bagasse because the quality of the bagasse fiber is much better than the vitista and the risista.

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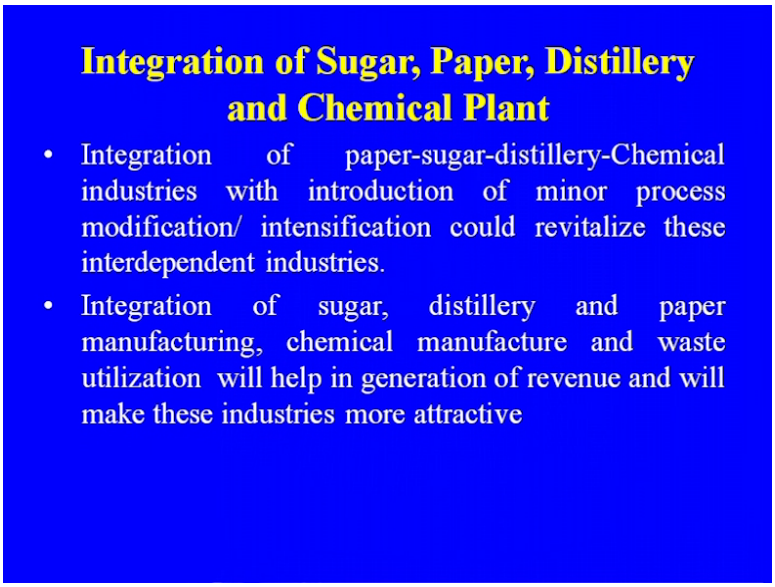

So, this is the how the integration modification and vitalize these interdependent industries. Integration of the sugar distillery and paper manufacturing chemical manufacturing and waste utilization will help in generation of the revenue and will make this industry more attractive. So, in the next slide I will show the how the sugar plant that

can be integrated because, now we are, some of the mills they are having the integrate from starting from the molasses.

Some of the units they are having this small paper mills integrated with the sugar plant and some of the mills only they are having they are using the bagasse and making the paper. So, there is scatter not integrated but, there is a scope of integration, because now we are talking about the integration of the petroleum refinery in the petro chemical. In the same way we can integrate this sugar plant, paper plant and the distillery.

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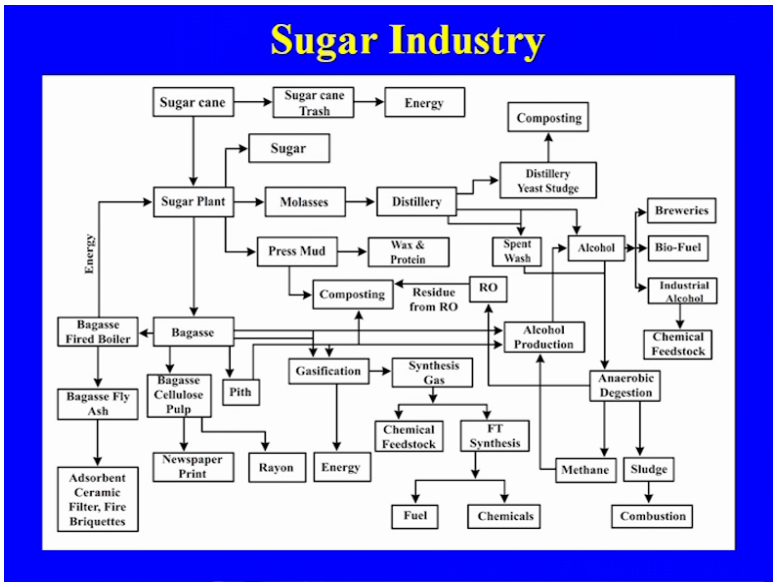

So, this is the how they, we can integrate the sugar cane manufacture. Then the sugar to sugar plant, sugar plant bagasse, bagasse it will go through bagasse cellulose pulp and that will go to the news print. That we can make the cellulose, that can be also used for the rayon manufacture and then the bagasse that can be also a source of energy. The bagasse fire boiler, bagasse flies that can be used adsorbent, ceramic fixture, fire briquettes that can be used. Then the here other sugar that will go to the you know we have already discussed.

Press mud, press mud which we are getting during the clarification of the cellulose juice, so that will go for the composting. Similarly, the molasses that will go to the distillery plant, from the distillery plant that will go to the spent wash you will be getting and this spend wash we are making the alcohol, and then the spent wash that will go for the anaerobic digestion. The again for the further settlement that you go the arrow system

and the rescue after treating the effluent from the anaerobic digestion, that can be used along with the press mud.

This is what some of the mills they have already started composting the press mud with the residue from the RO. Then alcohol, alcohol that will go to the breweries that will go to the bio fuel breweries that will go for making of the industrial alcohol, that will and which can be use the chemical feed stock, which already we discuss in detail, about the what are the chemicals that can be derived from the large number of chemicals.

Most many of the chemicals, which now we are making from the petro chemical route that can be and that was made earlier before coming of the naphtha cracker or the gas cracker plant, when the availability of the ethylene that was less, so that was being produced through the ethanol route. So, this was about the integration of the sugar plant with the paper mill or the chemical, so just to conclude about the role of the sugar industry and the alcohol industry in the chemical that can be vital.

You see the it is not only the sugar for you are taking, the only the purpose of… We are also manufacturing a large number of the other products that is the alcohol very important product where generating bagasse; that can be a very important source for the paper making. That can be source of some of the chemicals also, that can be a source of alcohol also and the alcohol which we are making that is not only the for the practical purposes, but that will be a major source of the your chemical feed stock through the ethanol.

Two various chemical or ethanol to ethylene and from ethyl to for making of ethylene. So the future of the sugar industry only the problem constant, which is there in utilization of the ethanol base ethylene or the ethanol as a chemical feed stock is the cost of production of the alcohol, cost of production of the ethylene and the bearing the volatile market of the molasses, which is not also the continuous supply of the molasses. So, these are the thing, but still in the feature when the there is a shortage of the raw material, we can utilize these various bio product from the sugar industry as a source of the energy, as a source of the chemical and for other purposes as a bio fertilizer.