Chemical Technology

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Module - 7
Petrochemical
Lecture - 7
Aromatic Production

We are discussing the module 7 of the organic chemical technology course. We have discussed the various petrochemicals, which you are manufacturing. Now, the two important topics that are remaining that are the aromatic production and the aromatics, different aromatics which are finding wide application in the organic chemical industry we will be discussing.

So, let us discuss first the aromatic production, because here in the production of the aromatic, there are lots of changes in the process technology from the initial stages where, the aromatics were only available through the coal chemicals through the coal carbonization from the co-cobalt plant. But with the coming of the catalytic environment, the development of the catalytic reforming process and at the same time with the pyrolysis gasoline which is rich in the aromatics and some of the condense sheet fractionation, some of the higher rating naphtha where the de-aromatation of the naphtha that can be done.

So, with the coming of these process plus some of the other process that has not develop in case of the aromatic production, aromatic production technology, aromatic conversion technology, where some of the aromatics like toluene or the meta-xylene are having the lesser use. So, conversion of this these aromatics to the more valuated aromatics that has; these are some of the advantage that has thing. Another development at the cyclo path; so all those things will be discussing in the coming in this lecture.

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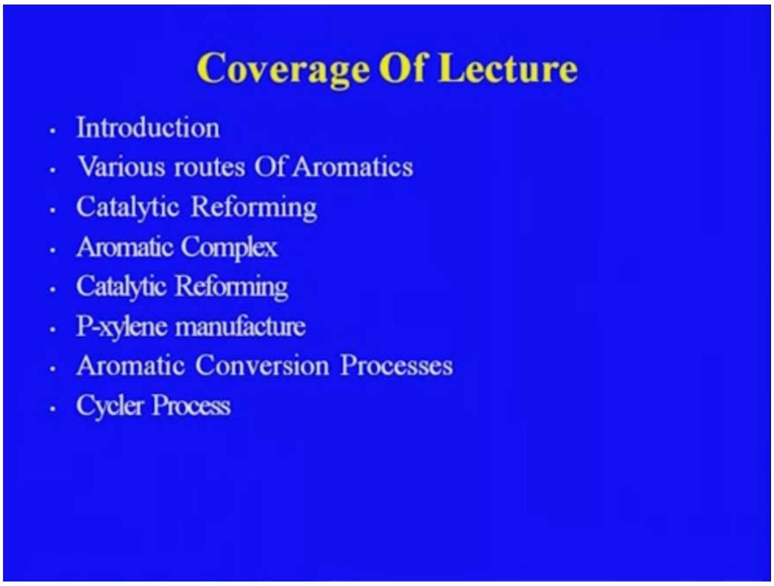

So, first the introduction about the aromatics, importance of the aromatic, various routes of aromatic, catalytic reforming aromatic. Although, the catalytic reforming part we have discussed in detail in the petroleum refinery the process is the same only here the catalytic reforming that is more which is more emphasis on the aromatic production or the gasoline and the development that has taken place in the process itself and just to have the higher aromatics in that.

So, then the aromatic complex P-xylene manufacture, which is again very important aromatics and the huge amount of the para-xylene that we are using in the manufacture of the DMT or the (( )) acid. Then, we will be discussing about the aromatic conversion process and in the last the cycler process where, we are making the aromatic from the propane and butane by the cycler process.

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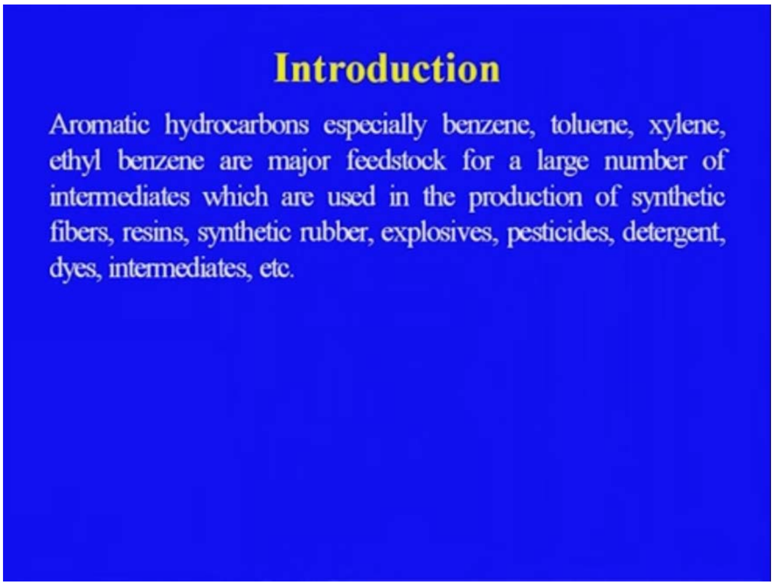

Aromatic hydrocarbon especially the benzene, toluene, xylene means the para-xylene, ortho-xylene that we are more interested. Ethyl benzene that is also, because one of the important feed stock for styrene are the major feed stock. Because during the process all these benzene, toluene, xylene, ethyl benzene that that will be there or major feed stock for a large number of intermediate, which are used in the production of synthetic fiber, resins, synthetic rubber, explosive, pesticides, detergent, dyes, intermediates and the industry huge amount of these your aromatics we are using.

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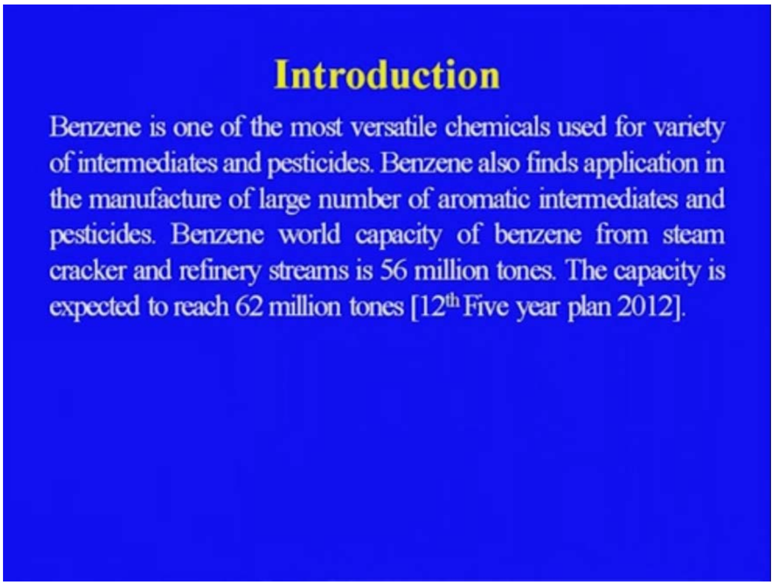

So, the benzene is one of the most versatile chemicals used for varieties of intermediate and pesticide. Benzene also finds applications in the manufacture of large number of aromatic intermediates and pesticides. Benzene world capacity of benzene from steam cracker and refinery streams is 56 million tones and the capacity is expected to reach 62 million tones. Other aromatics which are of the important product from the aromatic that you are getting is styrene from the ethyl benzene, cyclohexane from the benzene because cyclohexane that is finding application in the manufacture, (( )) of the first benzene is converted cyclohexane and then, cyclohexane that is been other solvents also we are using.

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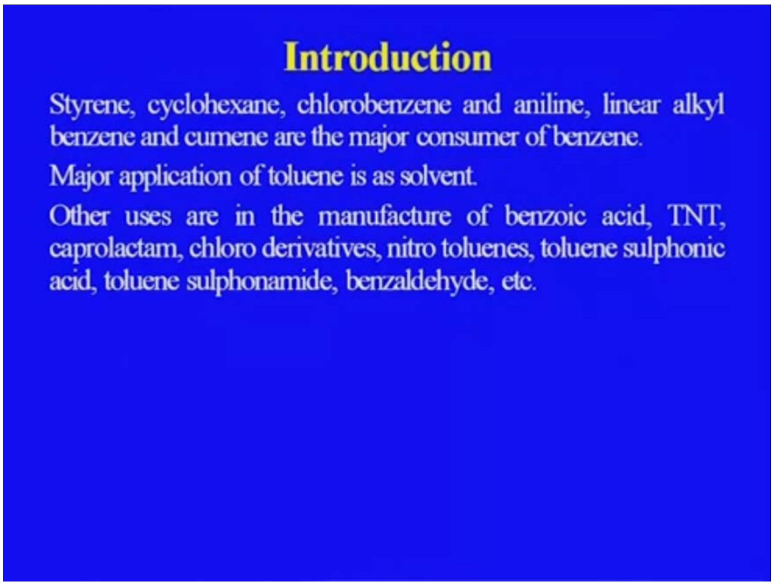

Chlorobenzene and aniline these are two another very important products which you are making from the benzene because the aniline that is the raw material from the dyes intermediate. Another product of the benzene is very important because we have already discussed that part that is, the linear alkyl benzene L A B which is because of the coming of the refinery benzene is available and so, that is change the whole actually the detergent industry static.

Another process as I told you the cumine from the benzene cumine route that is for the making of the phenol that is also the major consumer of the benzene. So, here while making the phenol other actually outlet because this is not a completely will be discussing while discussing the aromatics in detail about the individual aromatics where the you see the came into phenol, phenol to bleach phenol and bleach phenol to polycarbonate like that the continuous use of these chemicals are there.

Toluene that is having the less application if you compare with the benzene or these para-xylene. So, the it is use as a solvent because the alternative processes which you are now using the benzene that was from the just like take the you take the in case of the caproilectum, that was the actually the benzene route that we are benzene to cyclo's route that we are using. But, ethylene to benzoic acid and then, the raw material that is also one of the route.

So, this is the other usage of the manufacture of the ethylene in the benzoic acid. One of the very important organic acid which is being used for the making of the large number of the organic chemicals TNT trinitrotylene because that was the explosive or although the now the new breed of the explosive that has come. But, the TNT that was one of the very important explosive during the world war 1 and 2 and the lot of the development that was there in the catalytic deforming process also to produce aromatics and so that aromatics which was required either for the synthetic fiber or for the your this explosive.

Caprolactam, chloro derivatives, nitro toluenes, toluene sulphonic acid, toluene sulphonamide, benzaldehyde. So, these are the some of the other product of the important product of the toluene.

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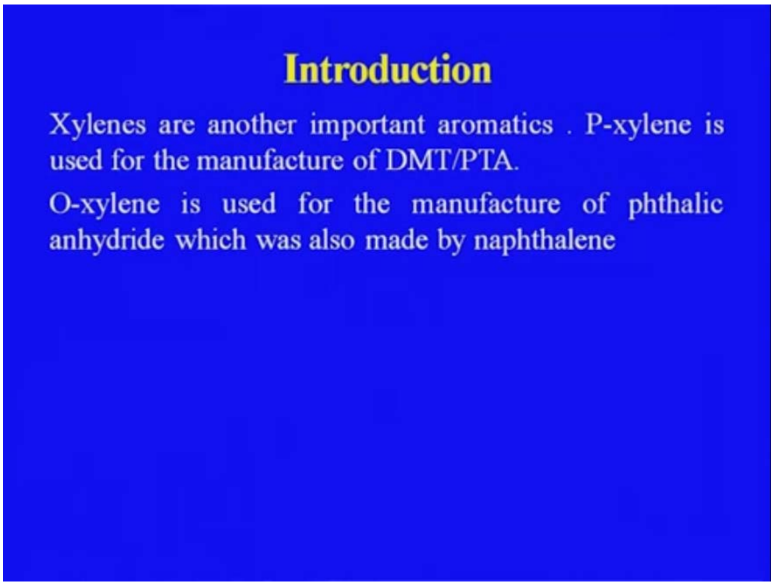

Xylene's are another important aromatics. Para-xylene is used for the manufacture of the DMT and tetralic acid. Ortho-xylene is used for the manufacture of phthalic anhydride because phthalic anhydride that is find wide application in the paint industry as plasticizer. Earlier the route was through the nephthaline route that was the route available RDA. But now all that has been produced from the ortho-xylene because ortho xylene is one of the major bi-product you are getting while making of the para-xylene.

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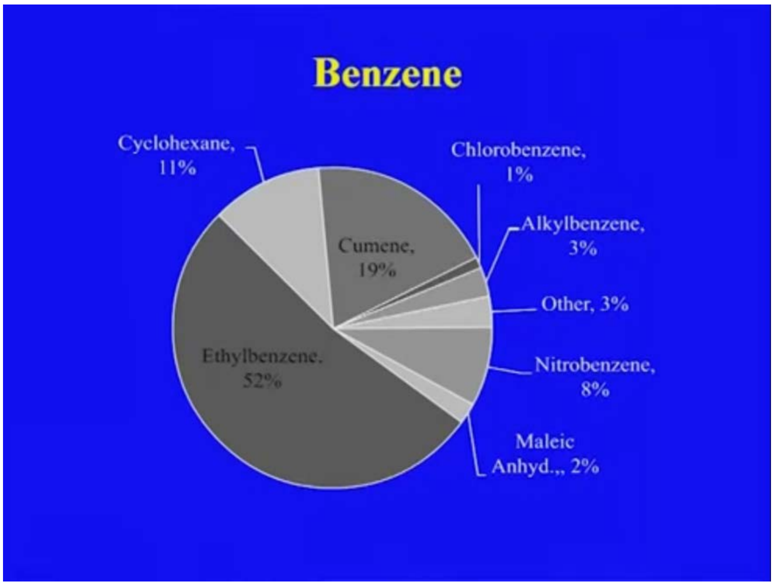

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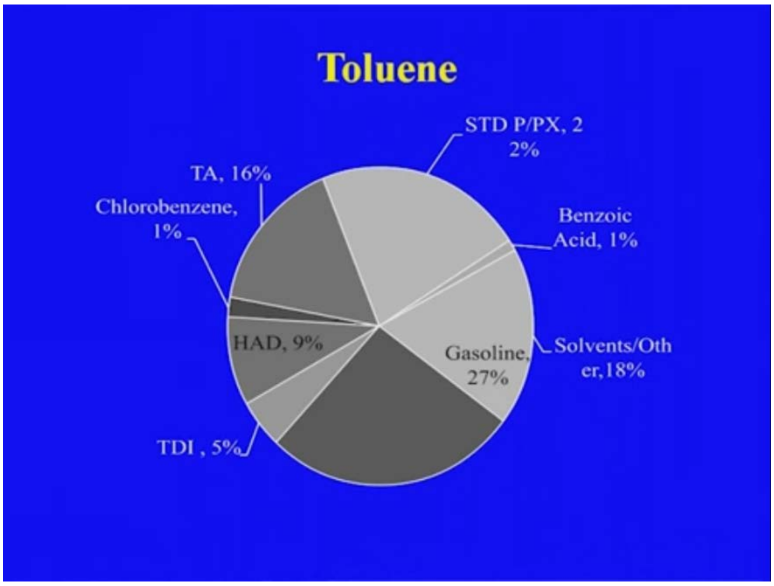

This is the actual status of and if you see the major portion that is going for the ethyl benzene, cumene and other products that is also there, nitro benzene or the anilines. But, major portion that is going to ethyl benzene and ethyl benzene to styrene. This is for the toluene that the gasoline you can because this is the very high octane number that you are having. But, other applications are also there.

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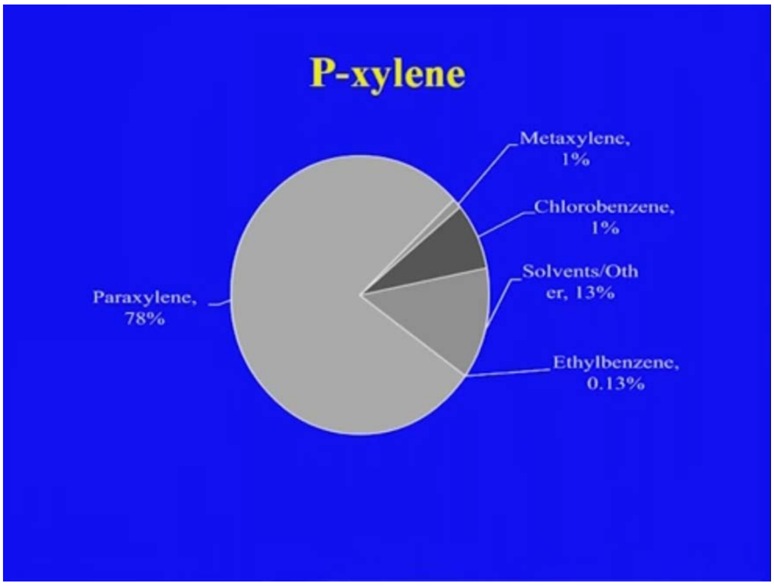

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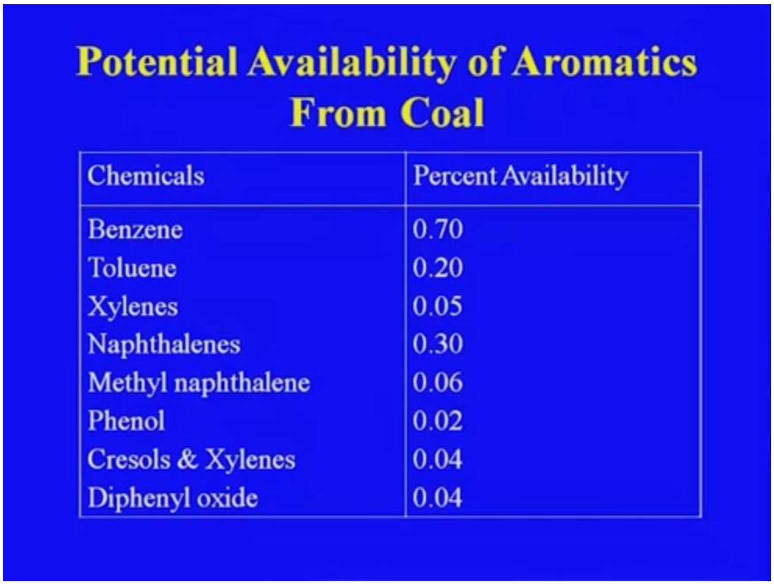

Potential Availability of Aromatics From Coal

Chemicals	Percent Availability
Benzene	0.70
Toluene	0.20
Xylenes	0.05
Naphthalenes	0.30
Methyl naphthalene	0.06
Phenol	0.02
Cresols & Xylenes	0.04
Diphenyl oxide	0.04

Similarly, paraxylene, this part is the maximum for the manufacture of the polyester means the terathylic acid. Other usages are also there, but these usages are less then what we are having a major portion that is going for the manufacture of DMT. That was the earlier route for getting the polyester now, the terathylic acid or the purified terathylic acid which is the raw material for the are the monomer for the your polyester industry.

You see the 1 of the (( )) getting the aromatics that was from the coal and that is one of the various your product that we are getting from the coal carbonization unit. And the yield around that is where you see the yield of the benzene, toluene and xylene that is much less then what you are getting from the petrochemicals and that was the reason why.

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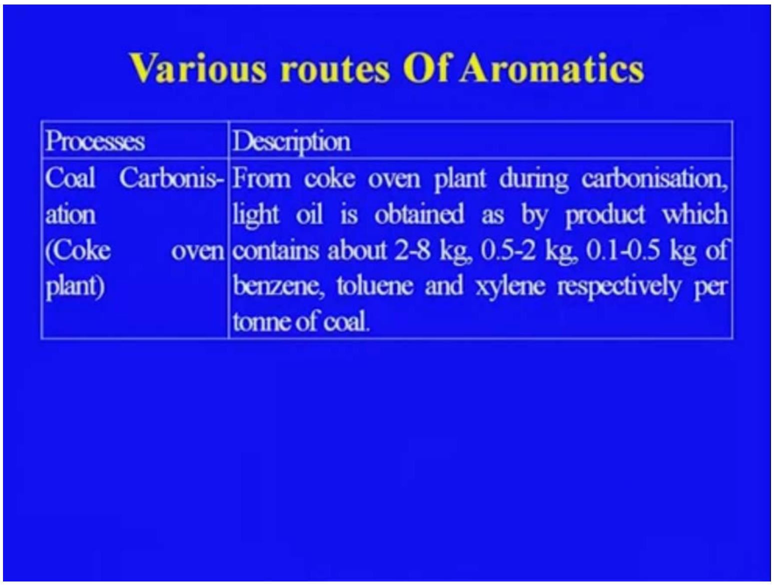

This is figure, which I was telling, 2 8 k g benzene, 0.5 to 2 toluene and 0.15 to 0.5 k g of the xylene; this amount of the aromatics that we are getting part end of the coal. So, definitely it is a very small quantity. But, you see the before coming of the catalytic reforming process where we are making the aromatic this was the source available for getting of the aromatic which was having the large application. Another route that is not the exactly the purpose of the production of the aromatic that was for the olefin. But during this steam cracking process we are also getting a complement steam that is the pyrolysis gasoline. So, that is why I have that part the steam cracking of the hydrocarbon.

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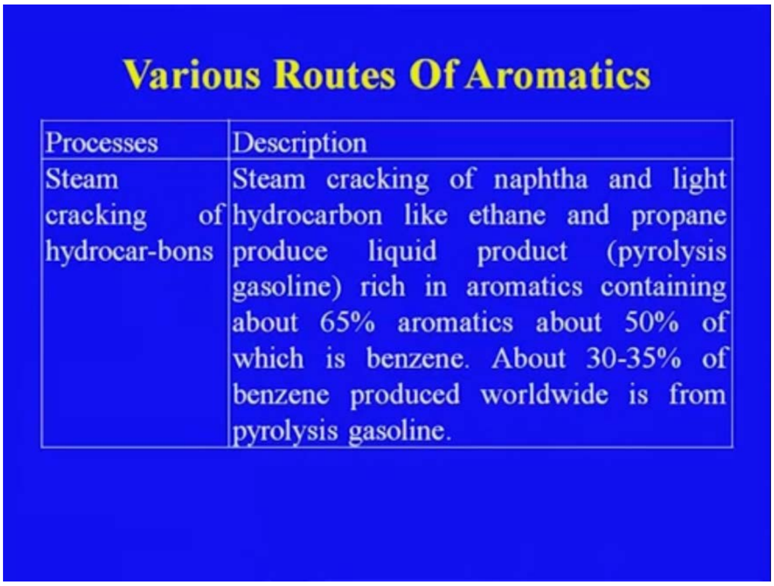

So, steam cracking of the naphtha and the light hydrocarbon like ethane and the propane produce liquid product pyrolysis gasoline which is rich in aromatics containing about 65 percent of the aromatics, about 50 percent of which is benzene, about 30 to 35 of the benzene produce worldwide from the pyrolysis gasoline, because as I told you the real also while discussing the cracking. Naphtha cracking the pyrolysis gasoline is more in case of the when you are having the naphtha cracking; and as we are having around 52 to 55 percent of the total feed as naphtha for the steam crackers.

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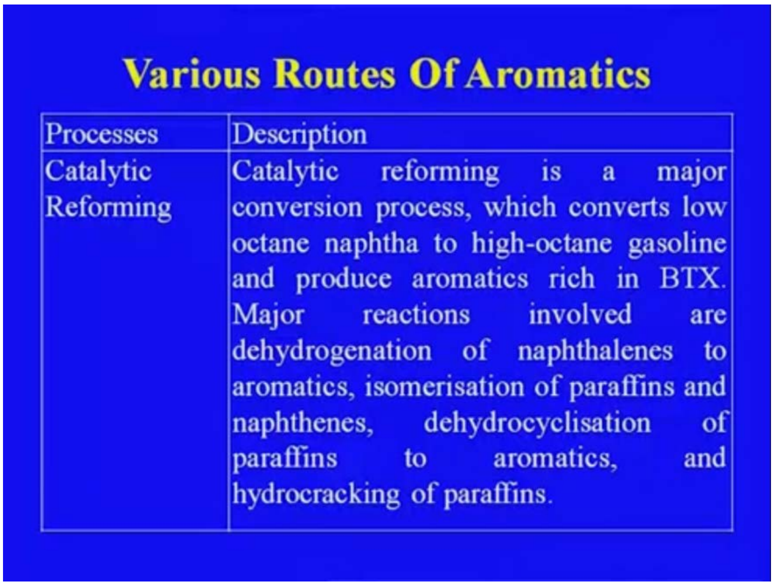

So, definitely the amount of the pyrolysis gasoline generated that is large. So, the major route for the aromatics that is the catalytic reforming process. Catalytic reforming means the same process, which we discuss in case of the petroleum refinery the module 6 that was the catalytic the same similar process we are using here also.

So, catalytic reforming is a major conversion process which converts low octane naphtha to high octane gasoline and produce aromatic rich in BTX. Major reactions involved are dehydrogenation of the naphthalenes to aromatics, isomerisation of the paraffins and naphthenes, dehydrocyclisation of paraffins to aromatics and the hydrocracking of the paraffins because this is the side reaction that is already we discuss in detail about the reaction and the feed stock, what are the various controlling parameter. Another process which is one of the commercial installations is also there, I think it is in Nigeria about this process.

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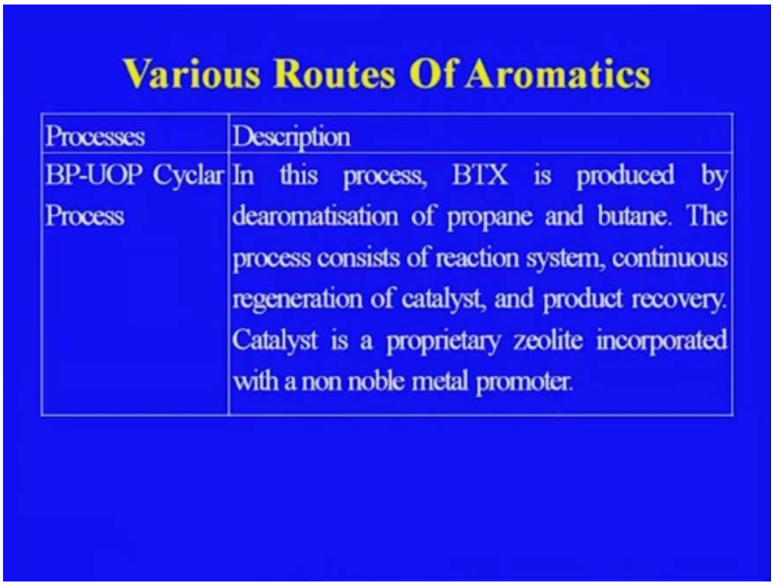

This process BTX is produced by dearomatisation of propane and butane. The process consists of the reaction system, continuous regeneration of the catalyst and product recovery. Catalyst is a proprietary zeolite incorporated with a non noble metal. Here, also we are having the series of the reactor, pre-heater are there just like the catalytic deforming process and we are getting the aromatics from propane and butane.

Another process the hydro-dealkalation disproponation, because these are the process that we are using for the dealkalisation of your toluene or the disproponation of the toluene and so that because to get the more valuated product. So, disporposination is also used in the process of the xylene, para-xylene manufacture or the meta-xylene that is having the less use of the meta-xylene that is converted to para-xylene.

So, isomerisation disproponisation are the isomerisation part that is there. So, in case of this, this is actually the so far the disproponisation is concerned this is only for the toluene, because in that process while making the para-xylene some toluene is also formed. So, that toluene (( )). So, some of the units they are also having the part of both the process are there in case of para-xylene isomerisation of the disproposition dialkalisation. Dialmadisation of the naphtha, as I told you the some of the naphtha they are very rich in the aromatic.

So, instead of going for the catalytic reforming this process involves the removal of the extraction or not the extraction of the aromatic from high aromatic naphtha feed without because now the number of your solvent that is available and so from that we are able to extract the aromatics from the naphtha. Here, we do not need any further reforming process for this making of the aromatic. The Process is full for naphtha having high aromatic.

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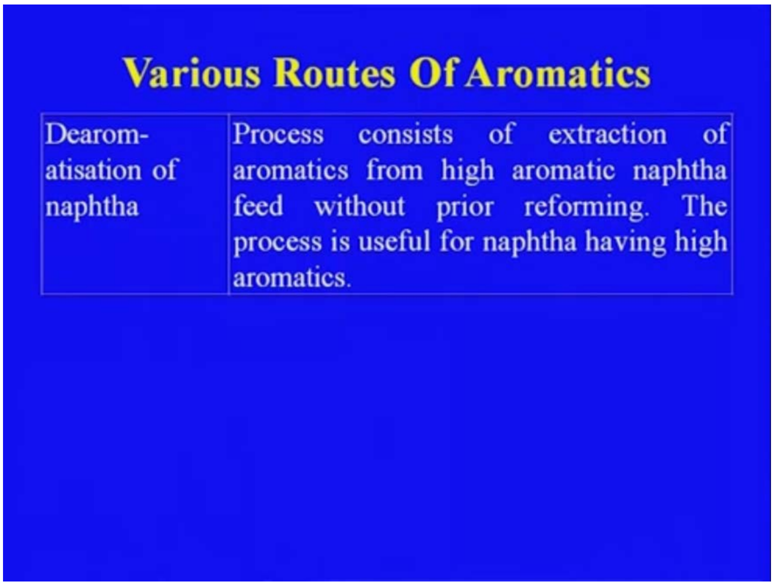

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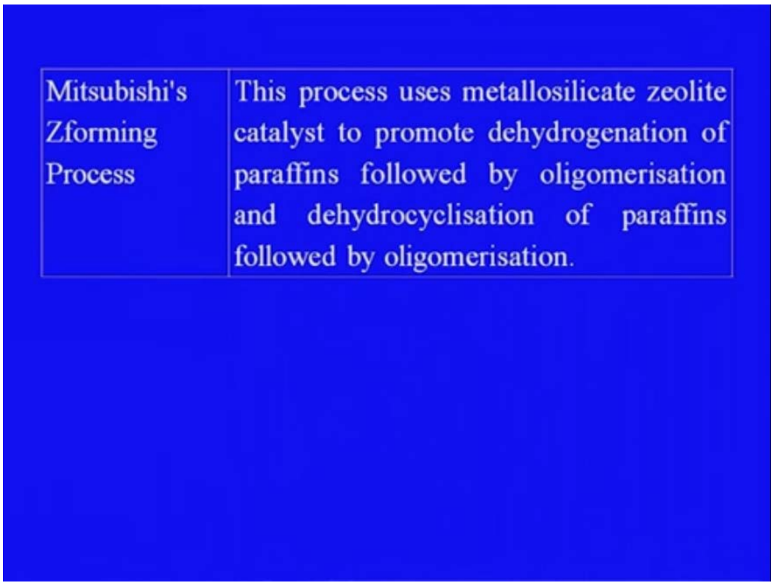

Z-forming process: This process uses metallosilicate zeolite catalyst to promote dehydrogenation of the paraffins followed by oligomerisation and dehydrocyclisation of paraffins followed by the oligomerisation.

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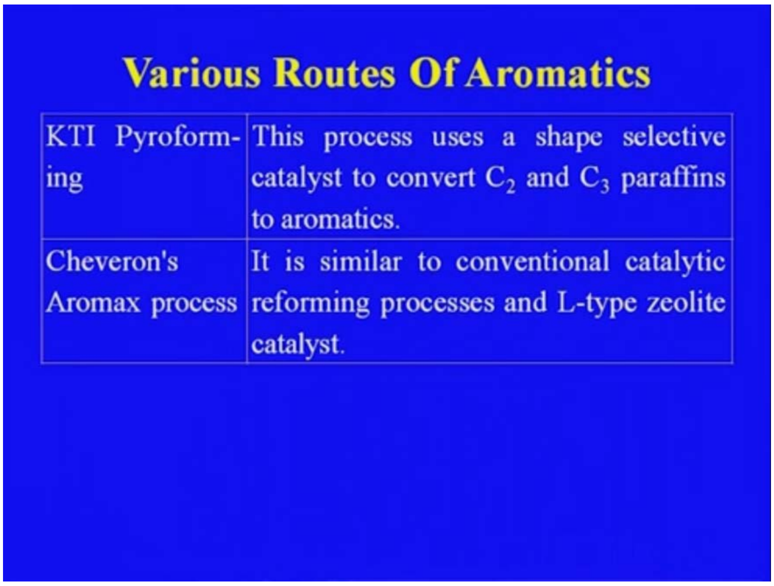

KTI pyroforming process: This process uses shape selective catalyst to covert C 2 and C 3 paraffins to aromatics. Cheveron’s aromax process: It is similar to the conventional catalytic reforming processes and L-type zeolite catalyst that we are using. Isomerisation and the isomer process: As I told you isomerisation process is also the part of the integral part of the paraffin process.

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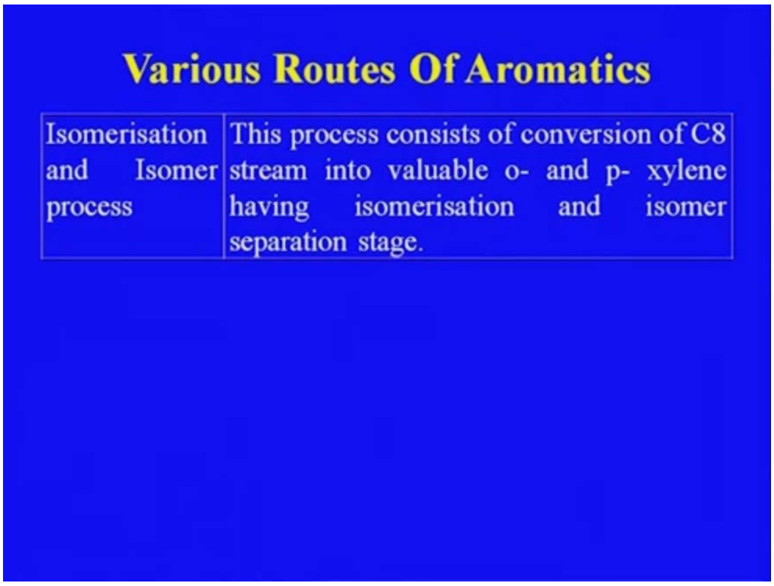

This process consists of the conversion of C8 stream into valuable ortho and para-xylene having isomerisation and the isomer separation stage. These are the two stages revolved in case of the isomerisation in it.

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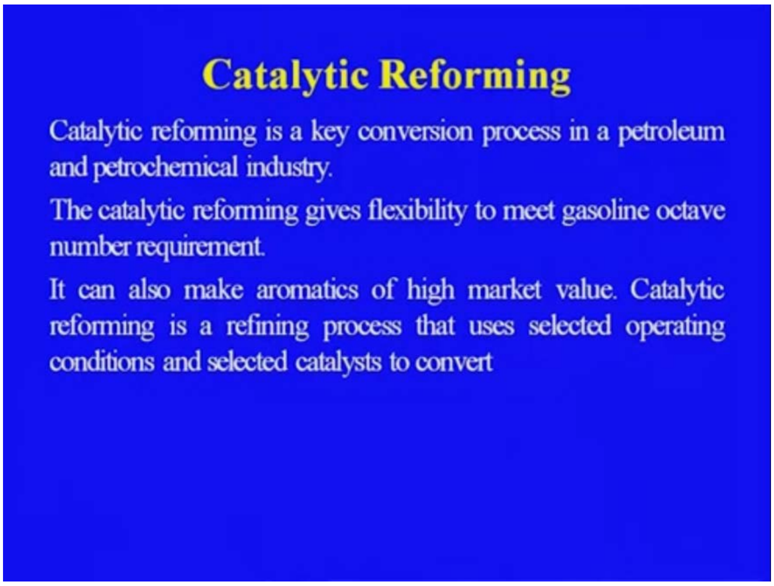

Now, let us discuss very brief about the catalytic reforming which we discussed in detail in the model 6; that the catalytic reforming is the key conversion process in the petroleum petrochemical industry. From the petrochemical point of view it is important for the protection of the aromatics in the hydrogen that we are getting as a bi-product and from the reformative you can separate this aromatic.

The catalytic reforming gives flexibility to meet gasoline octane number requirement. It can also make aromatics of high market value. Catalytic reforming is a refining process that uses selected operating condition and selected catalyst to convert the low oxygen naphtha to the high octane naphtha and the more aromatics. Basic objective of the catalytic reforming is as I told you, the refinery it is the sum of the catalytic reforming process in the refinery. They are producing the benzene or separately only the xylene as in case of the BRPL which I told you earlier refinery in petro chemical they were making earlier DMT, but now the plant has been closed because of coming of (( )) is in the market. So, there they are having the only xylene plant.

Panipat refinery, ISC Panipat refinery they are having the catalytic reforming and the para-xylene plant is there to produce high value aromatic hydrocarbon such as BTX. So, these are the some of the objective of the catalytic reforming.

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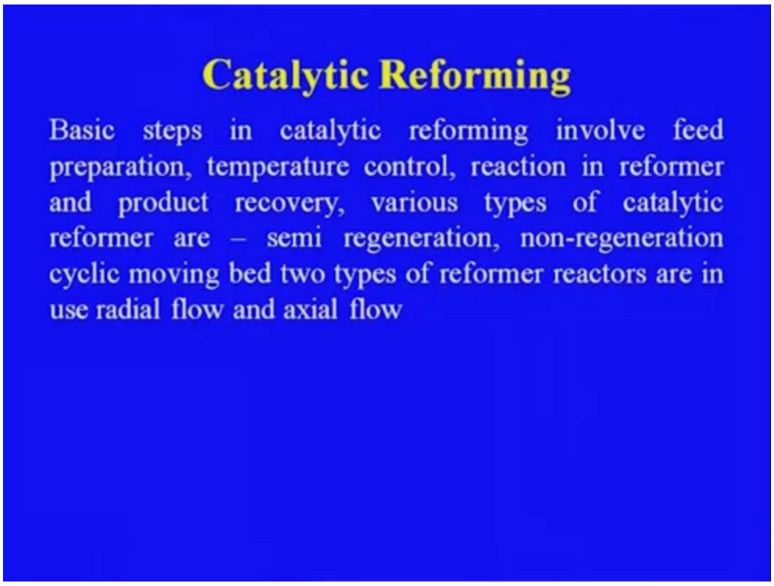

Basic step just I will go quickly because already we have discussed the feed preparation, temperature control, reaction in the reformer and product recovery. Various types of the catalytic reformer are semi regeneration, non-regeneration cyclic moving bed. 2 types of the reformer reactors are in, it may be radial or the axial flow.

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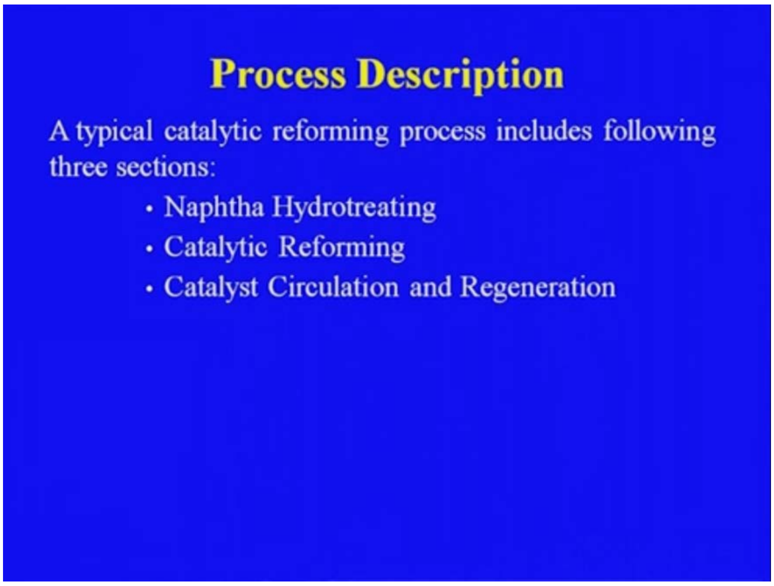

These are the various steps involve in case of the catalytic reforming, naphtha hydrotreating catalytic reforming, catalyst circulation and the regeneration. These are some of the reaction, dehydrogenation of the main reaction, isomerisation dehydrocirculation of the paraffins, hydrocracking reaction that is taking place simultaneously because that is the high temperature involvement is there and so that is undesirable part of this. Major units of the aromatic complex, because that was the catalytic reforming process, because we are making the aromatics. Then the next section in case of the aromatic plant that may be the separation of the.

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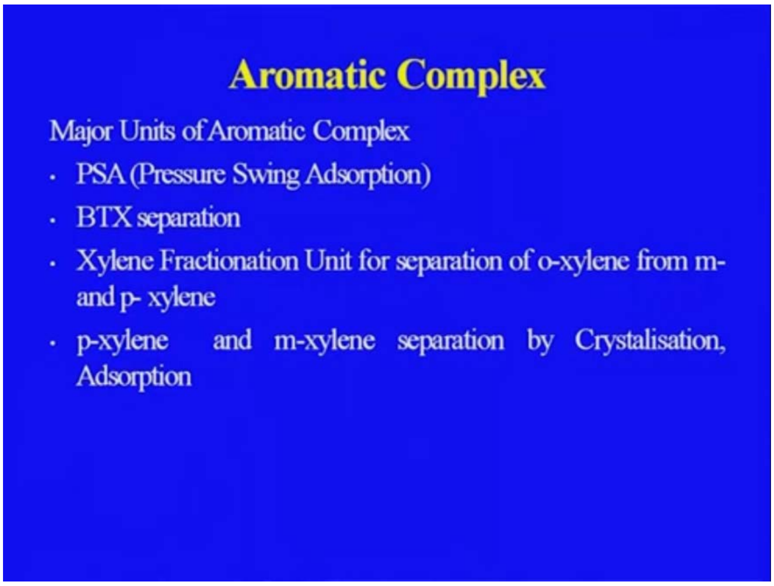

So, we are having the PSA pressure swing adsorption, BTX separation. Pressure swing adsorption that we are using in case of the para-xylene separation that is the parex process. Xylene fractionation unit for separation of the ortho-xylene from meta and the para-xylene because they are the boiling point of the ortho-xylene meta and para. Ortho xylene is around 140 degree centigrade and meta and para-xylene they are having they are the close warning component around 136 to 137 degree centigrade.

So, the separation of the meta and para-xylene is there. So, that is the 2 process we are using on the your I told you the pressure swing adsorption second process that we are using the crystallization. So, adsorption here is the parex process and there are also combination of these 2 process hybrid process for the crystallization and the adsorption both are the adsorption process parex that has been developed by U P.

So, both the process are there hybrid process where the combination of crystallization and adsorption. So, what are the steps in case of the BTX because as I told you the boiling point of BTX when benzene toluene xylene is different. So, depending upon your requirement a definite fraction of the naphtha that will have to take here and here also one of the requirement that will be the naphthene rich naphtha so that the more and more aromatics.

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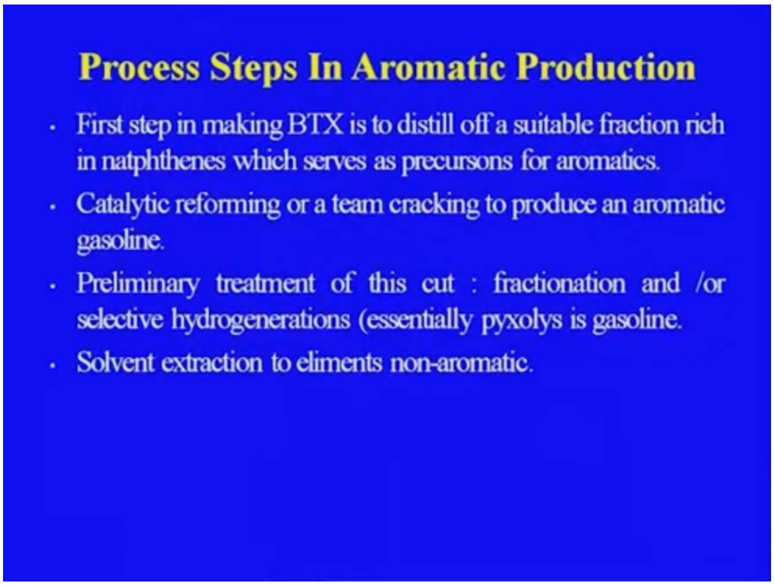

So, first step in making BTX is to distill off a suitable fraction rich in the naphthenes which serves as a precursors for the aromatics. Reforming or a team cracking to produce an aromatic because these are the pyrolysis gasoline that can be combined after the hydrogenation but they removal of impurity then, it can be combine with the reformate for making for separation of the aromatic. Preliminary treatment of this cut fractionation and selective hydrogenation essentially pyrolysis gasoline. Because that hydrogenation that we are doing in case of the pyrolysis gasoline because it 2 stage process is there. Then, solvent distraction because during your catalytic reforming process aromatics and now both are so, non aromatic component that has to be separated.

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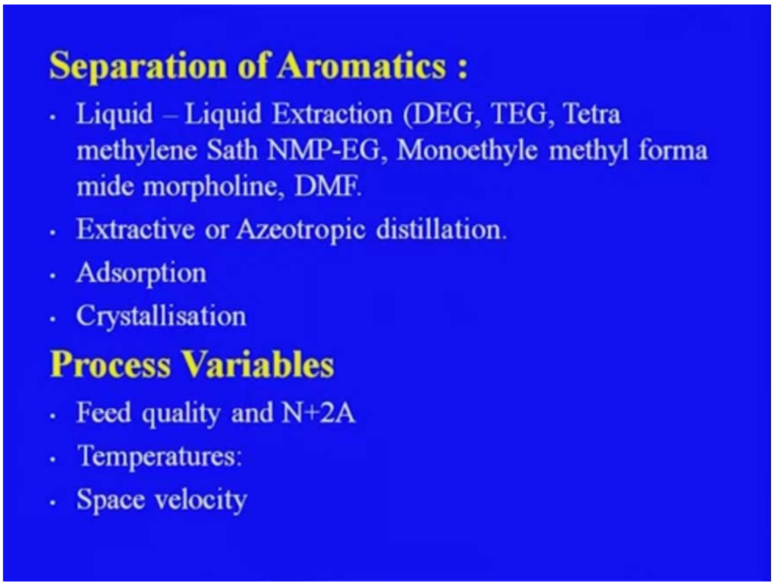

So, various separations of the aromatics we are having the liquid-liquid extraction, extractive or azeotropic distillation, adsorption and the crystallization. Process variable in case of the aromatic process and the catalytic reforming: feed quality temperature space because if you are using the feed quality means if you are interested for the only para-xylene then differently plus 110 fraction of the naphtha that has to be taken. If you are interested all the three product then, the lower boiling in naphtha that will be used.

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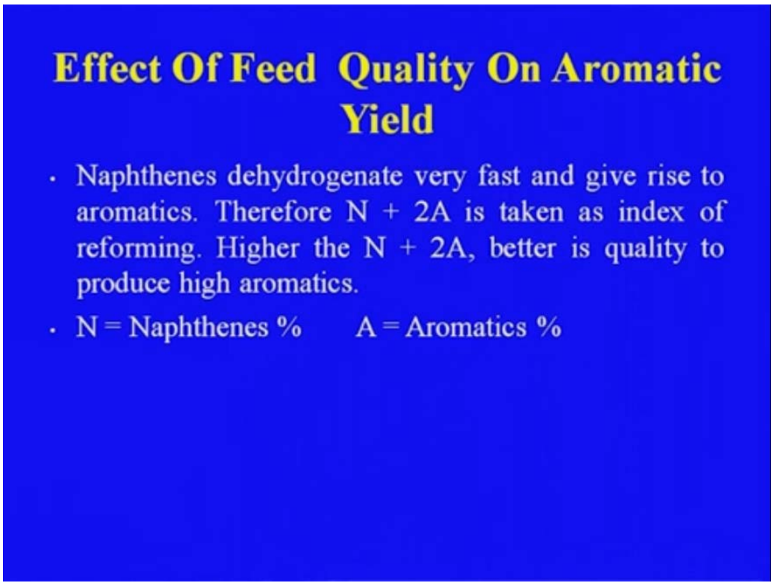

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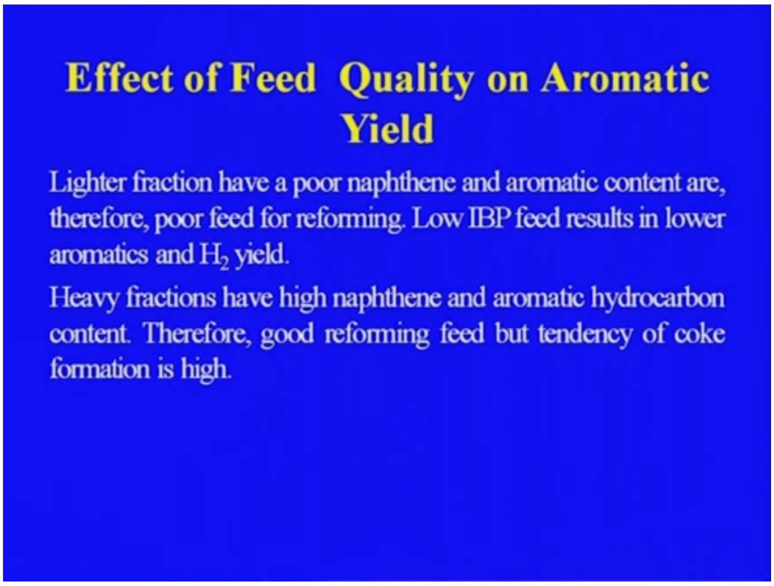

So, this was already we discuss N plus 2A importance of the N plus 2A because that will show the effect of the feed quality on the aromatic. Lighter fraction have a poor naphthene and the aromatic contain are therefore, poor feed for the reforming. Low initial boiling point feed results in aromatics and hydrogen yield. Heavy fractions have high naphthene and aromatic hydrocarbon content. Therefore, good reforming feed but tendency of coke formation is high in case of the heavier fraction.

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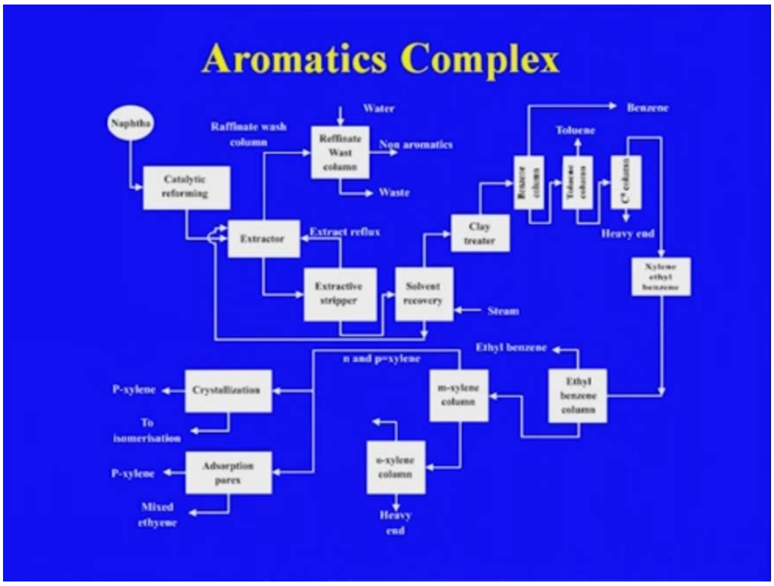

This is the typical aromatic complex where the combination of the catalytic reforming and the separation will be discussing separately. Then, it will be more clear where we are having the extractive discussion for the separation of a aromatics from the non aromatics then, the clay treatment and then, the various distinction column where, separating the benzene which is the lower boiling point toluene and xylene mixture that will we can.

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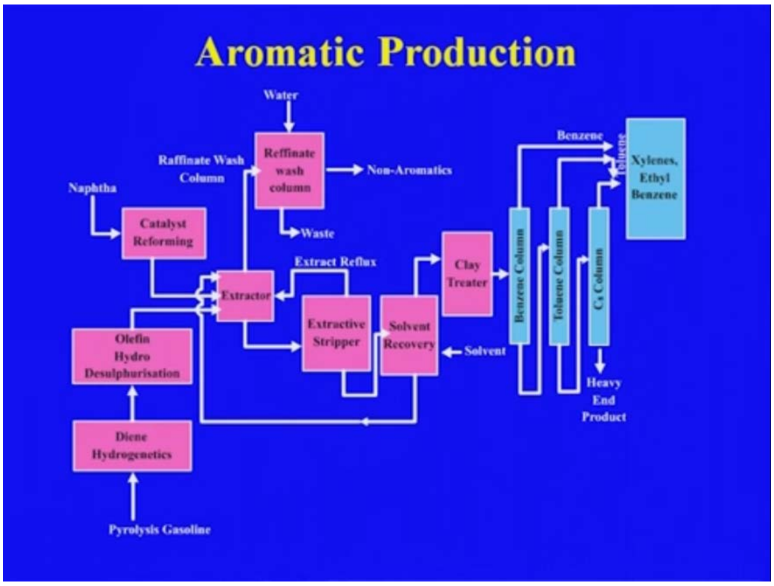

And that xylene mixture which CH hydrocarbon which will also contain the ethyl benzene then, the separation of the ethyl benzene and further fractionation that will give me ortho xylene and then the mixture of meta and para-xylene which we separated by crystallization and the adsorption process.

This is the process which I was telling the 2 important feed stock for their aromatic production that is, naphtha and this is the pyrolysis gasoline. So, two stage hydro desulpharation process in case of the pyrolysis gasoline and then the naphtha it will go to the catalytic reforming, separation of the non-aromatic fraction and then finally, it will go to the different column for the separation of the benzene, toluene and xylene and xylenes and ethyl benzene. So, the separately because this part, this is the part up to. So, many of the refinery what they are doing they are separating only benzene and list of this tune that is going to the real steam. But in case if you are interested for a para-xylene then all the this further it has to be separated.

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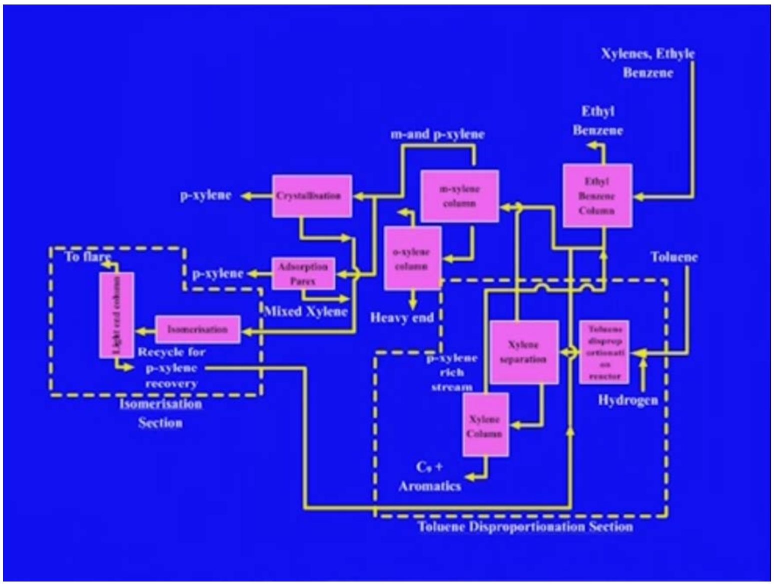

This is the process we are using in case of the separation because this is the again what about your after the separation of the toluene and ethyl benzene. Mix xylene that we are getting containing the ortho xylene para-xylene and meta-xylene. And the xylene or meta and para they are having the close boiling point. So, they cannot be separated by the distillation. But, ortho xylene which is having around 140 degree centigrade boiling point so that is separated by distillation here.

Here you see this is the separation of the xylene a meta and ortho that is the p para-xylene rich in steam and so that is the ortho xylene that you are separating from this column. This is the column where the ortho xylene because you are mix and the C9 hydrocarbon first that has to separated before it is going for the separation of ortho, meta and para-xylene. So, here you see this is the meta-xylene that is separated at 140 degree centigrade then, we are having a mix xylene means the para and meta-xylene.

So, separation that was the initial because this was the development in case of the aromatic production. Otherwise, earlier this crystallization process was not developed well, adsorption means the parex process were not developed. So, removal of the separation of that was there problem. So, this is the how the we are having the 2 processes now it is available and that is been used by different petro chemical complexes where we are making the para-xylene separated by crystallization or it may be there adsorption where we are using the parex.

Just like we discussed about the LABD, it was the molex. In case of the olefin it is the olex process here, it is here the pallax process. Then, again after the separation from the crystalline crystallization and the adsorption again it is left with the mix xylene it will be more meta-xylene. So, as I told you the meta-xylene that is having very less application; so isotehric acid that is only application major application of the meta-xylene. So, what we are more interested in case of the your para-xylene part, it is the more production of the para-xylene. So, what about the meta-xylene that is left? That is going to the isomerisation section.

Similarly, the toluene which is available in the process which is having the less use. So, we are having the toluene this proposition which I told the various aromatic conversion technology. So, this is the another process that is the 2 section in some of the plant only isomerisation section is there and some of the units are there where the isomerisation and the. And from the isomerisation again we are separating the para-xylene. Because you see the major as i told you the major portion of the para-xylene is for the manufacture of tetralic acid and with the coming of the polyester and the teratylic acid DMT which is the monomer or which is the major raw material that has been lot of the impact on the synthetic fibering industry.

So, this is the process of making because these are the units which are there in case of the apart from the catalytic reforming; catalytic reforming for the production of the aromatics and then the separation of the aromatics benzene, toluene, ethyl benzene, xylene. And then the conversion of the meta-xylene ortho-xylene to the more valuated product para-xylene. So, this disproportination or it may be the isomerisation in case of the meta-xylene to para and the ortho.

So, that is the how the your para-xylene plant which are the part of the DMT or the TPL manufacture they are operating. So, this is the actually as I told you the feed stock that is playing important role in the production of the product we are getting from the catalytic reforming. And as here our objective in case of the petro chemical complexes is the production of the benzene and the xylene. Because the benzene that is required in case of this bed the LAB, they are also making or it may be the other usage for the capro electrum as in case of the they are getting benzene from Indian oil.

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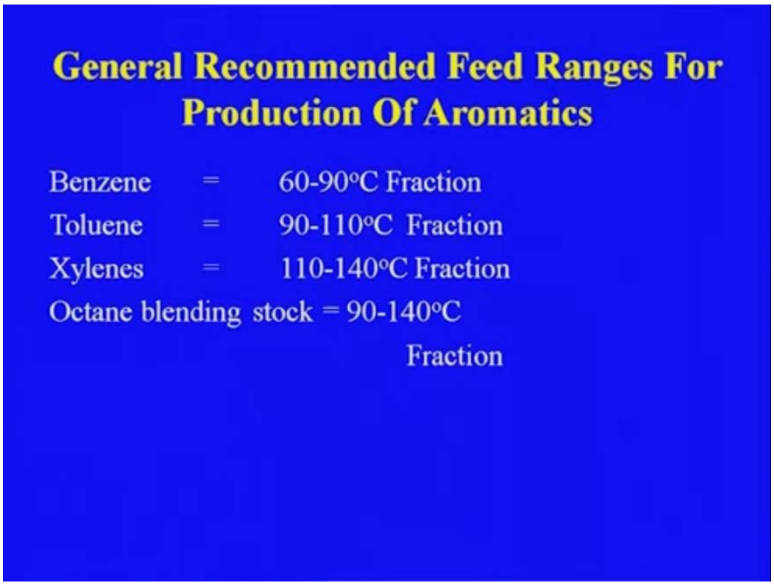

And so the xylene’s that is the fraction you see; the xylenes, the fraction of the naphtha which will be taking here 60 to 90, 90 to 110, because if you are going beyond this, more formation of the toluene will be there. So, our interest is here in case of the benzene because you see the refineries they are operation both in the gasoline and just like BPLC. We take in case of the BPCL they are separating the aromatics, in case of the Reliance, in case of the Panipat refinery, this madras refinery MR.

These are all madras refinery are now the Cochin and this Madras or Chennai petroleum refinery that is taken by the Indian oil. So, in all they are earlier refinery they are producing the benzene depending upon the requirement. So, you will have to go for the price of the feed stock accordingly and the different fraction of the naphtha which will be taking. And if you are using for the octane bending then, a broad range naphtha that you can take. So, as far the xylene is concern only this fraction of xylene that has to be taken.

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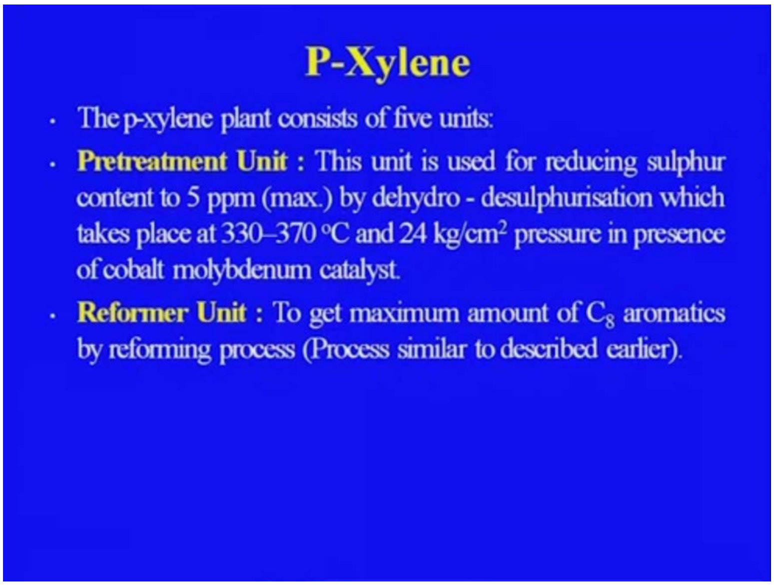

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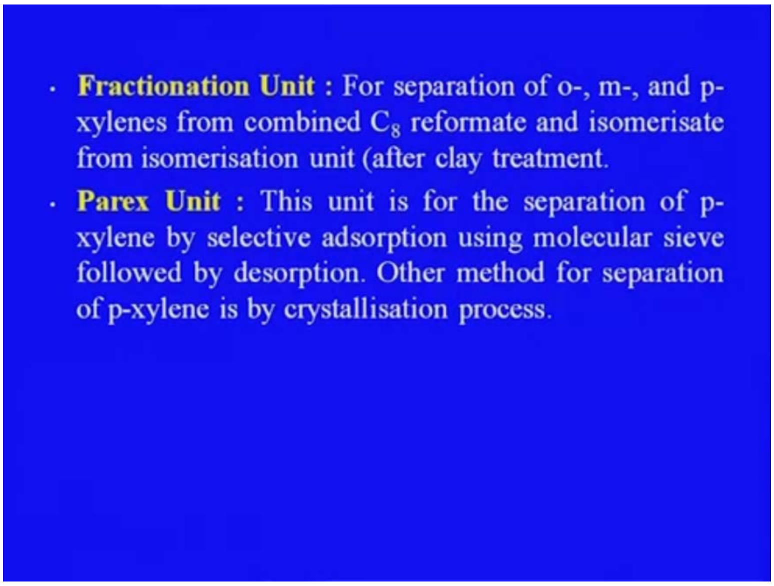

These are the some of the units which discussed in the flow diagram for the para-xylene. Just I will go quickly. The pretreatment unit: This unit is used for reducing sulphur content because the removal of the sulfur that is very important. The reformer unit, catalytic reformer unit: To get the maximum amount of C 8 aromatics by reforming process similar to catalytic reforming process we are having the same type of the units, same type of operation that you are doing only our objective is towards the more and more benzene or the xylene.

Then, the fractionation unit for the separation of ortho, meta and the para-xylene from the combined C 8 reformate and isomerisate from the isomerisation unit after the clay treatment. Parex unit: This unit is for the separation of para-xylene by selective adsorption using molecular sieve followed by desorption. So, this was the real breakthrough you can say in the production of the para-xylene, the coming of the parex process.

Now, other process let them have also the developed this process for separation of the para-xylene. But it was the main create the role of the UOP which developed this process. Other methyl process separation of the para-xylene is the crystallization process and we are using this process also in some of the plant. Reliance they are using the crystallization process for the separation, other units they are having the parex unit for the separation of the para-xylene.

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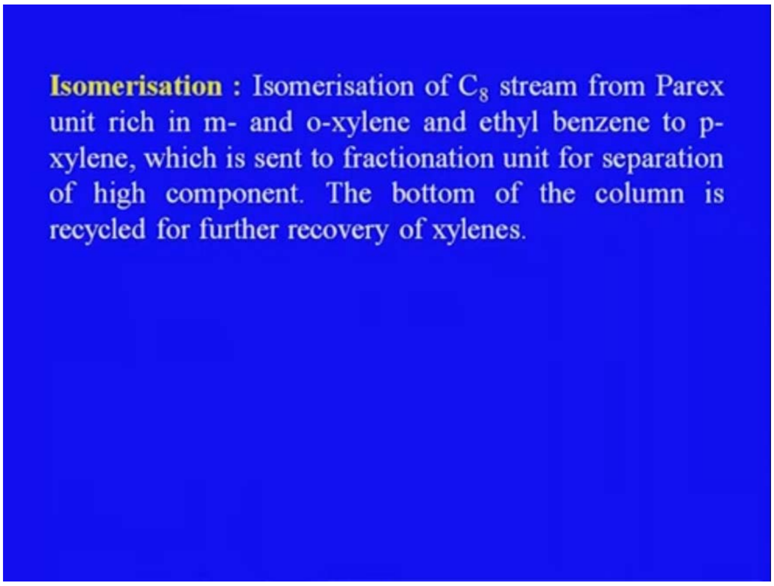

Then, the isomerisation and the dealkalisation: This is also the part of the many of the refinery isomerisation of the C 8 stream from parex unit rich in the meta and the ortho-xylene and ethyl benzene. Because the ethyl ortho-xylene that is very less ethyl benzene to para-xylene which is sent to the fractionation unit for separation of the high end component. The bottom of the column is recycled for further recovery of the xylenes.

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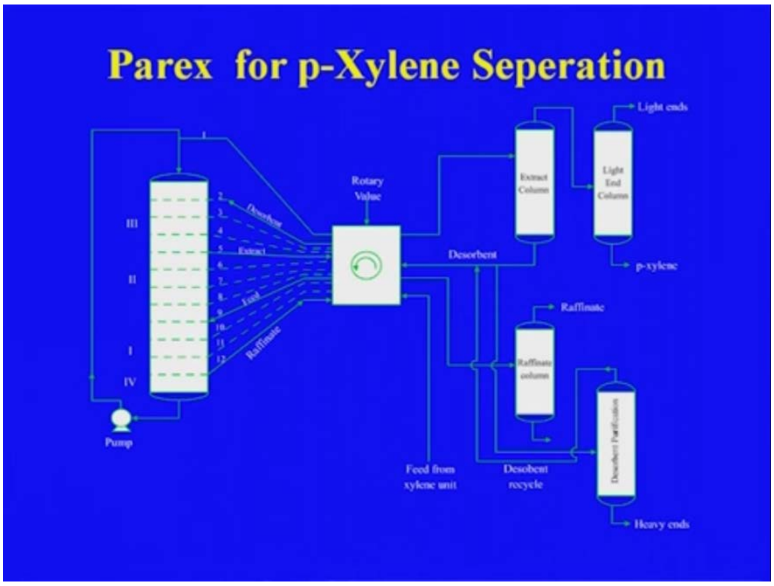

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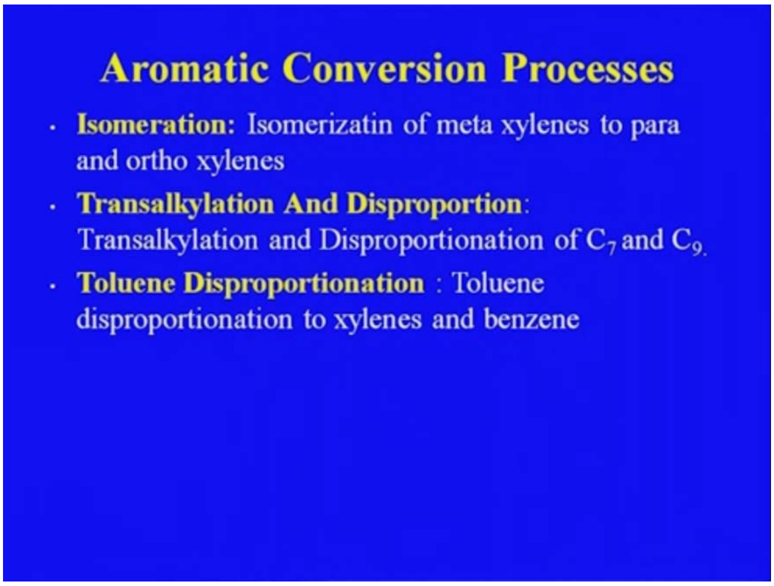

This is the parex process where the continuers adsorption and desorption that is taking place and then, the recovery of the stack, recovery of your the disrobement that is there and so the finally, we are separating the your para-xylene. So, this is the process, this the continuous operation of the valves are there and the here input of the feed and then, the feed outlet all those and the addition of the disrobement. All these are taking place simultaneously in this continuous adsorption column. The same process is there also in case of the molex process.

Now, let us in discuss the very brief about the various aromatic conversion process. One of the very important is the isomerisation process, Isomerisation of the meta xylenes to para and the ortho xylene. Transalkylation and disproportion that is the transalkylation disproportion of C 7 and C 9 steam. Toluene disproportion: Toluene disproportion up to xylenes and the benzene, where these are the some of the options available for converting the low value product with the more value added product are in the process I told you in case of the xylene if you are making a some toluene it will be also there, meta xylene will be there.

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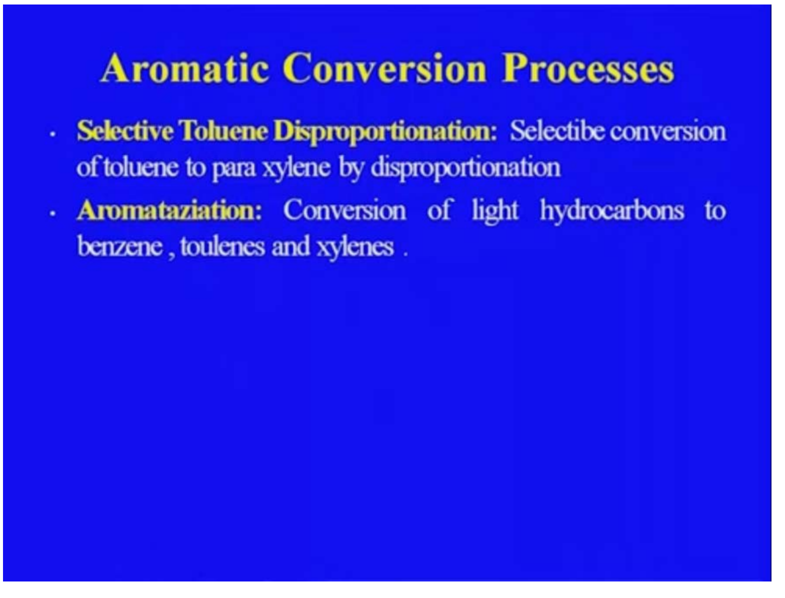

So, how to utilize this effectively to increase the productivity or the reduce the cost of the para-xylene manufacture? That will be the isomerisation or the toluene disproportionate that may be there. Aromataziation that is the conversion of the light hydrocarbon comes to benzene, toluenes and xylene similar to your reforming process.

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These are the some of the aromatization process that is cycler process, aroforming process, M-2 forming or the Z-forming. These are the some of the processes for the aromatization. Now, let us discuss about the cycler process that is one of the very important route for making of the aromatics that is through the natural gas.

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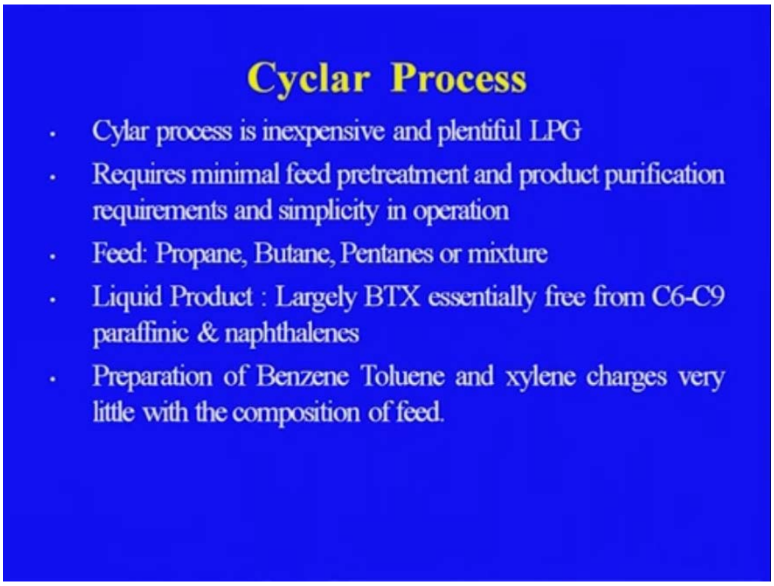

So, cycler process inexpensive and plentiful as the LPGs there, even because you see the many of the refinery then, the naphtha or that was surplus. They were thinking to go for the LPG mode, cracking of the naphtha to LPG mode or in the LPG that is available from the various process in the refinery itself. All LPG that we are also separating from the natural before it is being supplied to the fertilizer plant. So, this LPG that can be used for manufacture of the aromatic. This requires minimal feed treatment and product purification requirements and simplicity in the operation which we are facing in case of the other conventional process.

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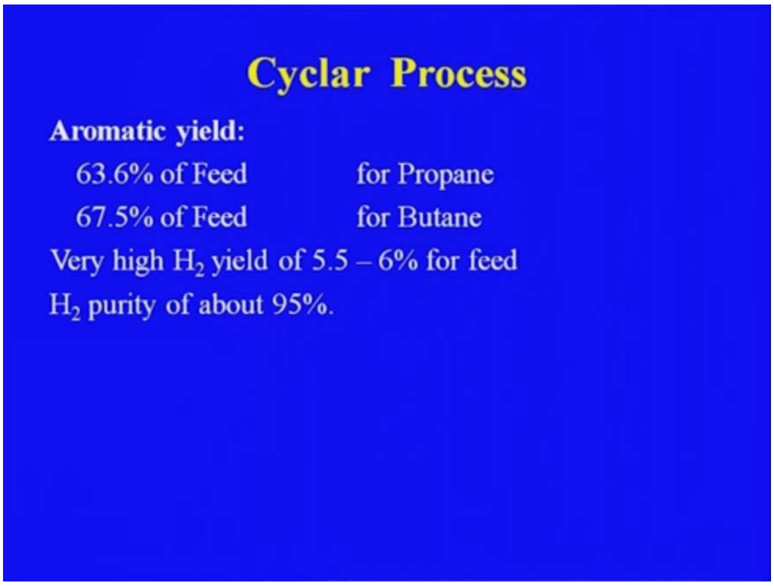

So, feed is propane and butane, pentanes or mixtures of these. Liquid product largely BTX essentially free from C6, C9 paraffinic and naphthalenes. So, this is more pure from other that we are getting. Preparation of benzene, toluene and xylene charges are very little with the composition of the feed.

This is the typical yield of the aromatics depending upon the feed either you take the propane or the butane you see the difference is not much in the your aromatics whether propane or butane or the propane butane mixture that can be taken. So, very high hydrogen yield 5.5 to 6 percent of the feed. Purity is about 95 percent and so, this hydrogen that can be use elsewhere.

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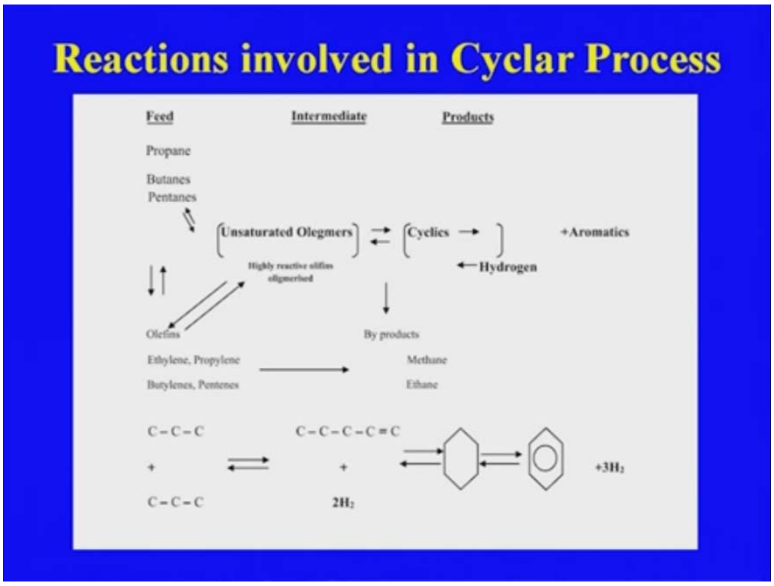

So, this was the cycler process that is being used for the, these are the some of the series of the reaction that is taking place from the in the cycler process where you getting the hydrogen which I told you the high hydrogen and this is the aromatics that you are getting. So, these are the series of the reaction that is taking place in the process of the conversion of the natural gas to the or propane butane to aromatics.

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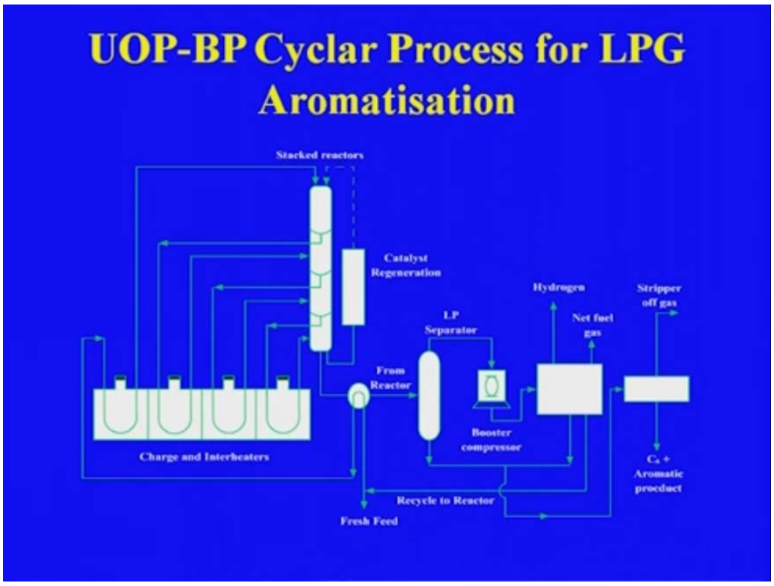

This is the typical LPG aromatization you need to develop by UOP and where again, we are again having the series of the reactors and this is the stack inter heaters and this is the reactors we are having the stack reactor. This type of the reactor also not being use in case of the catalytic reforming. So, stack reactor and the inter heaters are there and finally, after your conversion it is going to the we are getting aromatic. So, this is similar to your catalytic reforming process, stack reactor, 1 reactor second so and the finally, continuous regeneration is also taking place.

So, this was about the aromatic production. Because you see now the many of the refinery they are going for the integration of the refinery with the petro chemical or even the organization which are producing your this gases only the gas, the oil and gas business ONGC now they have enter in the petro chemical business also. So, the aromatic production that is going to be enhanced by the various operation because they have availability of the raw material. Another route that may be the condensed at which are the aromatic rich naphtha that can be separated. So, these are the some of the process we discussed in the aromatic production.

In next lecture will be discussing in detail about the various aromatic product, why the importance of the aromatic is there. So, the changes in the refinery operation especially with the coming of the polyester and the L A B plant because many of the refineries now they are operating, they are catalytic reforming for the production of the benzene as well as para-xylene or this they are having this.

You take the case of the patal ganga. When the patal ganga was operated started was the polyester the PTA and the LAB. Similarly, when the nirma they started, they needed the benzene for the LAB plant that was supplied by IOC. Similarly, Gujarat state and fertilizer complex they used the benzene from the IOC. So, this was the importance of the aromatic production unit. So, the next lecture that will be on the various aromatic compounds.