Indian Institute of Technology Kanpur

National Programme on Technology Enhanced Learning(NPTEL)

Course Title
Bioenergy

Lecture -33
Feed Stock Treatment

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So welcome back to the bio energy course so in the last class we started about the gasification last two classes we dealt with gasification we talked about the basic concept of gasification followed by the chemistry involved in it the two stage combustion process which is involved unlike the regular combustion which is a one-step process, so when you started you decided that we will have this section in five different sub headings we started with the introduction we talked about the basic chemistry.

And then we were supposed to talk about the pretreatment of the feedstock or the biomass to be used followed by the properties of the biomass and final phase will be the design of the gasifier what are the different kind of designs and what are their advantages and disadvantages and what is output and efficiency so we have talked about the introduction we have talked about the basic chemistry.

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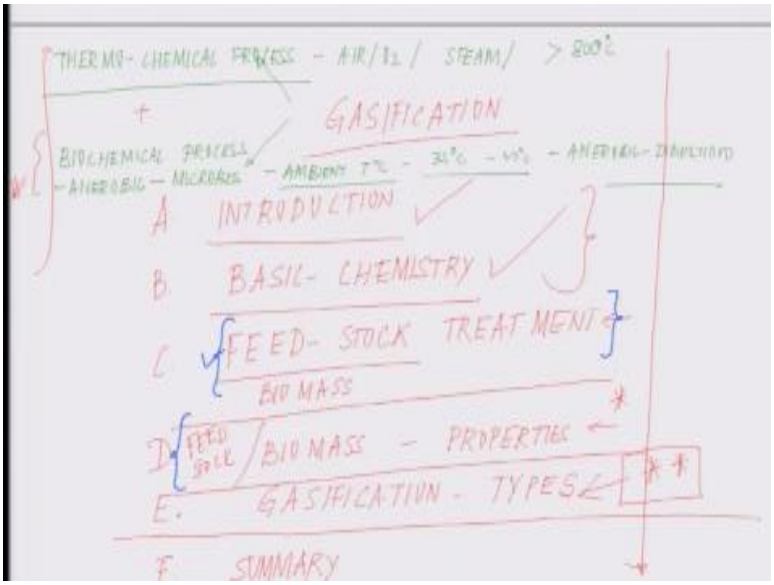

So today what we will be starting off with we will be talking about this part the feedstock treatment followed by the feedstock properties okay so let us resume today with these two aspects.

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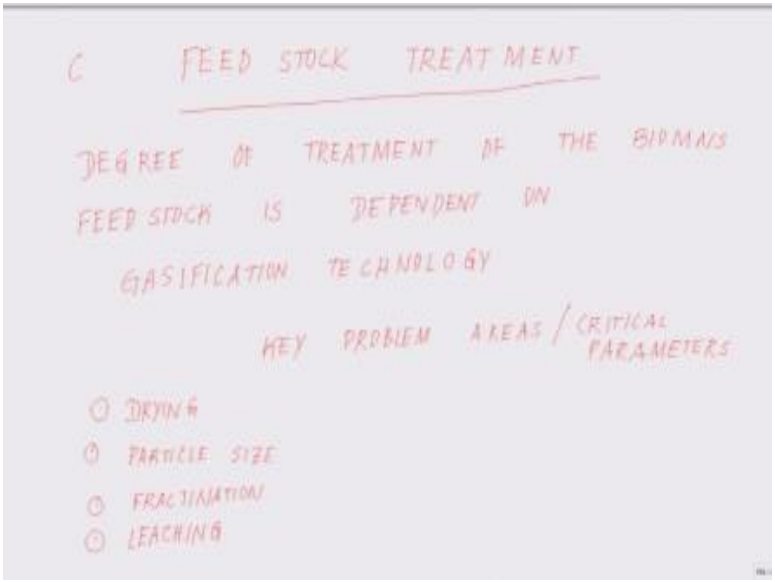

So we will be talking about feedstock treatment which is our section 3 or Part C of classification okay so what we do in bed well feedstock treatment, essentially feedstock treatment varies or is a function of two different parameters one is what kind of gasification process we want to follow will it be an thermo chemical will it be a biochemical or what kind of gas cease fire will be using weather will be using fluidized bed or we will be six bit will be coming to this all this classification.

Plus what kind of materials we are using is it a wood or is it a crop residue is it some other form of bio waste depending on the treatment protocol or the treatment methodology varies and as a matter of fact here will be just covering some of the basic parameters these basic parameters will remain constant in day-to-day practical problem solving one has to improvise upon these basic parameters suppose you wanted to convert a banana waste okay or some kind of a fruit waste or some kind of vegetable waste some kind of a wood waste.

So for each one of them they will be coming with some inherent issues which has to be resolved under the basic parameters okay so let us enumerate what are the feedstock treatment things so in

terms of the feedstock treatments degree of pretreatment or you can call it a pretreatment actually.

Because before you introduce it into the gasifier degree of treatment or pre treatment of the biomass feedstock is dependent on the gasification technology biomass feedstock is a function of the is dependent on or is a function of gasification technology okay so this comes with some critical issues what we will be doing we will enumerate the key problem areas for seed stock treatment okay key problem areas or critical parameters critical parameters.

So among these critical parameters one aspect is the drawing will come one by one into them let enumerate all of them second one is the particle size particle size of the feedstock third thing is fractionation and the fourth aspect is leaching these are the key problem areas which we will be discussing and as I mentioned just couple of minutes back depending on the kind of feedstock you will be coming across which will be used for converting or for gasification you have to improvise upon these basic parameters okay.

So there is no set uniform rule that these things will always work no you will have to modify it okay so now let us talk about the drying parameters okay so we have enumerated all of them now one by one we will be talking about the individual parameters.

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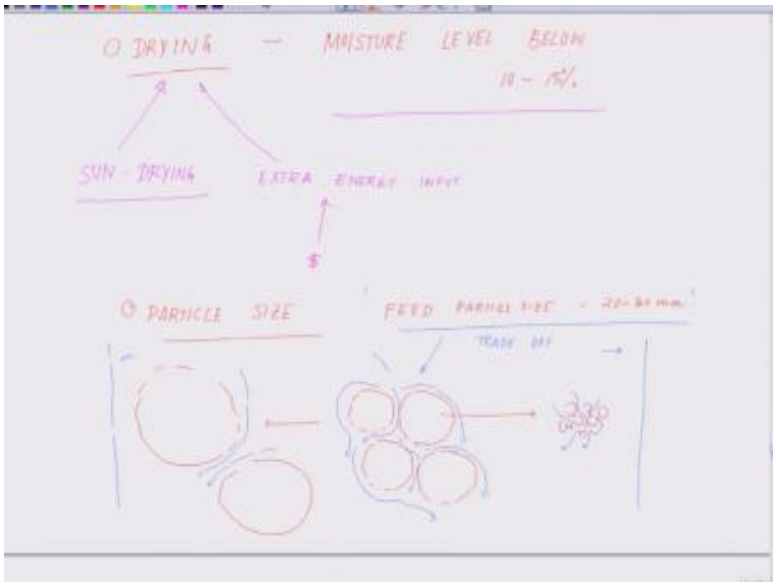

So drying so in terms of drying the moisture level which is most optimal which is considered as kind of work most of the time much around ten to fifteen percent of it moisture level below ten to fifteen percent so typically around nine or sometime will be 12 or something where you will get the best results but when we talk about drying one has to realize that this is another thing always keep in mind I have highlighted this point earlier again.

I am highlighting that needs energy or there are two ways you can draw a sample either you have one route will be Sun drying this is very common in dryer parts of the world semi-arid tropics tropical regions as well as drier part of the earth where humidity is low you really can write so this is energetically favorable because you really do not need to consume energy all you have to have extra energy input for drying, whenever we give an extra energy input.

So it means you are spending certain amount into it okay you are spending some money into it so that adds up to the fuel costs whether we will talk about the economics these are the points one has to take into account what kind of sample or what kind of feedstock you are obtaining to be processed okay so this is the moisture level below ten to fifteen percent this is one of the critical point second we will talk about the particle size.

So particle size atypical particle size is which is followed feed particle size is around 20 to 80 millimeter which is in terms of the diameter we are talking about feed particles ride around 20 to 80 millimeter so here one aspect one has to realize so just say for example this is the particle face okay and here you have the gas which has to know percolate through and the blue I am drawing the gas so you have to have a very optimal particle size.

The reason being of course one can argue here that if there are two things before we put forward the argument is the maximum area of the particle should come in contact for the reaction to take place that gives us an idea that if we reduce, now if you follow this if I reduce the spice so this much like this will have more and more area under the more and more will be covered by the gas molecule or the reaction area will be much more higher.

But if we do so we come across a problem which will be dealing later is this will lead to a clogging many a times the finer the particles it leads to some form of a clogging at the different orifices of you know Aurora phase or exhaust orifice and it reduces the efficiency of the system whereas if you go up with a particle size something like this you are compromising on the reaction area.

So you have to go for an optimal particle size and that optical particle size will be a kind of trade-off you will be doing essentially so there will be a trade-off which will be doing in order to get the maximum out of a gasifier system and this particle size parameter again though I am giving you 20 to 80 millimeter this kind of varies with system to system it is not a very uniform one but this is the kind of range where one can kind of ball partner this is where most of the gasifier will get decent amount of efficiency okay.

So this is the next aspect to be taken into consideration about the pretreatment okay the third aspect is fractionation.

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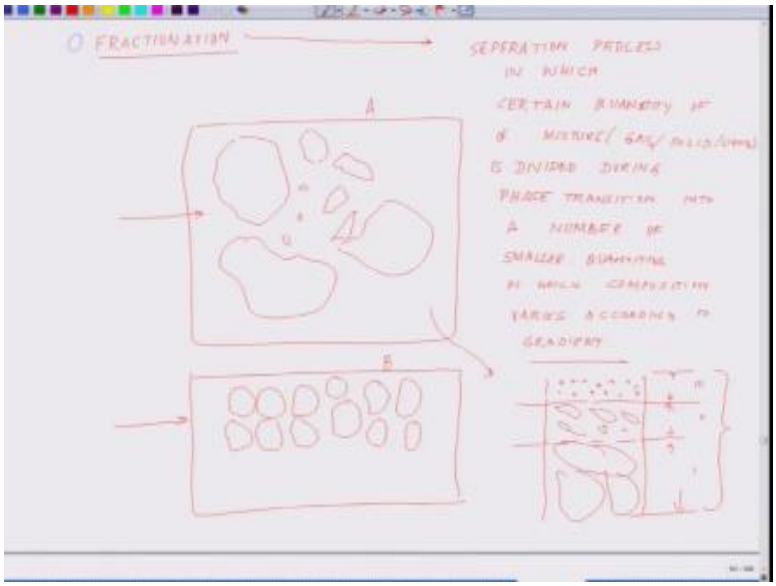

Fractionation so what is Fractionation, so fractionation as the name indicates you are fashioning the system in other words what does that mean it is a process by which you separate the sample depending on their particle mass or whatever you pick up a parameter so it is kind of a gradient what you create so that your reaction can take place in a much more uniform fashion because say for example you have a mixture of different size of particles.

So the reaction time will be very tough to be predicted just for your understanding, say think of a situation a particle this big a particle this is small particle this all different sizes coming through now if I ask you that how much time this thing will take will be very tough for you to predict as compared to if I give you a second scenario which is here in the next box what I am drawing now if this is the Box a in the box would be if you think of it if I give you a uniform particle size like this.

Something of that kind now more or less in any form range so you can do a prediction much better so fractionation is a very important tool which comes very handy in terms of the pretreatment of the feedstock and by definition fractionation means we go by the technical definition fractionation a separation process as I mention you in the beginning it is a separation

process in which certain quantity of certain quantity of mixture and it could be gas solid liquid is divided during phase transition okay.

Phase transition into a number of smaller quantities okay in which composition in which composition varies according to gradient composition varies according to gradient so this is the most simplistic definition of Fractionation so if I had to fractionate this box a then what I will be getting is something like in a column I will have this bigger particles sitting somewhere here then say one category and the second set of particles sitting somewhere here again category different groups and I have the smaller particle sitting down here which is the category three.

So these are the different categories by which you can fashion it now in this context when we talk about the fractionation terms.

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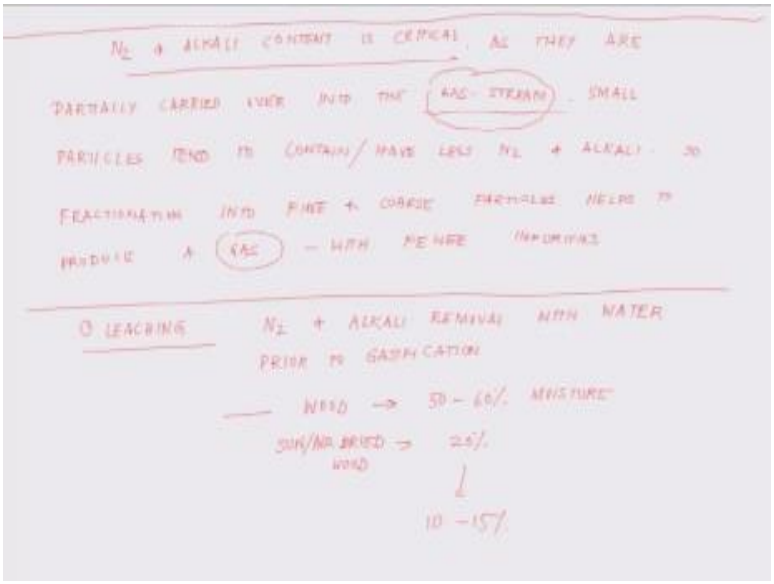

Of this very critical to know that nitrogen and alkali content is critical and as they are partially carried over into the gas stream so I put it down alkali content is critical okay so following up the previous one if we have a way around that if we could fractionate some of these materials like

you know nitrogen alkali and all these different kind of things we may get a better efficiency of the system.

So we talked about the particle size earlier so we started with the drying process then we following the particle size and then we talked about there are ways to separate it out by fascination and now we are talking about these two parameters especially nitrogen as I have told you in the previous class also nitrogen can become a big impediment in gasification process and the alkali content they are very critical and what one has to do is that since these are very critical as they are partially carried over.

Into the gas stream so essentially what is happening your gas stream which is coming out is now contaminated with nitrogen and alkali so small particles tend to contain small particles tend to contain or have less nitrogen and alkali so fractionation into fine and coarse particles helps to produce a gas or product gas with fewer impurities okay so this again revise it what we talked about we talked about first that the drying the moisture level should be less than ten percent or between ten to fifteen percent for sure and preferable below ten percent.

So again we talked about the particle size we cannot afford to a very fine particles because we make clock the different ports and the gasifier and we cannot have a photo of a very big chance the reaction would not happen so we have to have somewhere between the very somewhere in between which is around 20 to 80 millimeter what we have talked about then we talked about how really two separate them out one can separate them out using fractionation columns and while using the fractionation column there are certain aspects which has to be removed or which has to be minimized very significantly.

One of us the nitrogen we have talked about it in the chemistry part of it how the nitrogen kind of you know reduces the calorific value of the seal just in the previous class if you go through you will remember it so we have to get rid of the nitrogen and we have to get rid of the alkali metal they could be caught rid of if we have a final part is not extremely finding I talked about if we have a decently fractionated sample of fine and the coarse particles we can really get rid of much of it okay.

So that is why we are all interlinked with each other in terms of the particle nitrogen content alkali content and likewise and so on and so forth okay so these are some of the basics followed by just aspect in it is the leaching okay reaching parameter so again coming back nitrogen and alkali removal with water this is another route by which you can remove it with water prior to gasification so say for example if we talk about the fresh wood just directly which is from the forest you are getting.

It contains fifty to sixty percent moisture okay whereas if we sundry or air dry sun or air dried wood this contains around twenty percent moisture whereas what we need is to go around preferably below 10 or at least between ten and fifteen percent so this brings us I stopped I told you that there is always a compromise because when you have to reduce the water content you have to expend energy we have to spend certain money or a daughter it for in order to do will be to reduce it and if you do.

So in other word you are increasing the cost of the final product because these are all your inputs okay so most of the pretreatment revolves around these four five parameters starting with the water content of the sample or moisture content which were we put it of the sample step one second thing is the particle size you are dealing with around 20 to 80 millimeter diameter particle size.

Mostly works for it and if you can then fractionate the particle at this and size classification the reaction becomes much more faster and this fractionation process into coarser and finer particle leads to significant removal of nitrogen and alkali metals which creates a lot of problem in the gasification process in terms of reducing the calorific value creating clogging creating really nasty tars and everything into the system and next approach is if you can leach out this nitrogen and alkali from the sample by key picketed water.

But if you keep it in water for long water treatment then you have to have our method to remove that water which will again consume that extra money in order to get it to below ten percent or between 10 to 15 percent moisture levels and we give an example that regular wood which you

obtain just fell from the just cut from the forest can consist contains around fifty to sixty percent moisture and if you are on right you can go down to life you know around twenty percent.

But still to any person is not good enough you have to bring it down further so these are the basic pretreatment techniques which are critical before we get into the gasification, so from here what we will do. We will move on to the next aspect of it which is basically the feed stock properties okay, so I will close it here, thank you.

Acknowledgement

Ministry of Human Resource & Development

Prof. Satyaki Roy

Co-ordinator, NPTEL IIT Kanpur

NPTEL Team

Sanjay Pal

Ashish Singh

Badal Pradhan

Tapobrata Das

Ram Chandra

Dilip Tripathi

Manoj Shrivastava

Padam Shukla

Sanjay Mishra

Shubham Rawat

Shikha Gupta

K. K. Mishra

Aradhana Singh

Sweta

Ashutosh Gairola

Dilip Katiyar

Sharwan

Hari Ram

Bhadra Rao

Puneet Kumar Bajpai

Lalty Dutta

Ajay Kanaujia

Shivendra Kumar Tiwari

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