From: alexis belonio <atbelonio@yahoo.com>
Sent: Thursday, January 17, 2019 7:10 AM
To: Anderson, Paul <psanders@ilstu.edu>
Subject: Re: Inquiry re blue flame from rice husk gasifeir

Hi Paul,

Good evening!

Below are the info I have with regard to silica in rice husk.

1. Rice husk contains around 20% ash and 90% of that is silica.
2. When rice husk is gasified, char is the by-product. It is around 30% of rice husk input. Ash in rice husks is commonly seen in direct combustion devices like furnace and step grate stove. In rice husk quasi-gasifiers like conical grate stove, mixture of char and ash can be found.
3. Because of the high percentage of silica in rice husk, gasifiers when operated at a higher temperature, that is by increasing the superficial velocity of gas at the reactor bed , the silica starts to soften and melt producing "clinkers." This makes the unit difficult to operate as a result of bridging and clogging. I encountered this in moving-bed downdraft units I have. This problem can only be eliminated by designing the gasifier at a specific gasification rate of around 100 kg/hr-m^2.
4. I believed that the char layer (depth and temperature of bed) when enough to crack the tar is the one responsible in achieving blue color flame in rice husk gasifier. Small burner holes, aside from speeding up the velocity of the flame to achieve higher heat transfer can help burning the tar before it leaves out of the burner. Also, when the gas leaving a reactor is thoroughly cleaned by wet scrubbing, more bluish flame can be obtained.
5. Continue operating the gasifier without rice husk left unburn, will produce cristobalite. This is similar to "clinkers." At higher temperature, silica turns into gaseous form. I always tell those who are using the stoves and combustors to cease the operation when there is no more combustible gas that is coming out of the burner. Increasing the fan airflow to further burn the char will produce white-colored flame (but not too hot) during operation.

Attached are the info I have for the different gasifiers I developed as funded by Ted Redelmeier of Carbon Neutral Common.

You can also find commercial models of stoves I have which were recently released here in the Philippines by Approtech Enterprises. Just Google or search at You Tube logging in "Biolexis."

Thanks and have a blessed weekend ahead!

Alexis

On Wednesday, January 16, 2019 1:16 AM, "Anderson, Paul" <psanders@ilstu.edu> wrote:

Stovers,

I thank Alexis Belonio for his highly informative comments (below) on blue flames and rice hulls. He also sends an update on his work situation.

I do ask Alexis for a further comment that relates to the silica Si or SiO or SiO2 as a factor, relating to thermite. It might have no importance. But the question about silica or silica oxide should be resolved. Is there no other chemical (metal?) present with which the silicon oxide might be reacting is some small but important way?

Paul

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From: alexis belonio <atbelonio@yahoo.com>
Sent: Monday, January 14, 2019 2:08 AM
To: Anderson, Paul <psanders@ilstu.edu>
Subject: Inquiry re blue flame from rice husk gasifeir

Hi Paul,

Good afternoon and thanks to your email!!

After leaving Carbon Neutral Commons early last year, I work back again full time at Philippine Rice Research Institute developing hydrous bioethanol as fuel as well as paddy dryer using rice husk gasifier as heat source. This year, I was given an assignment to develop a biomass gasifier with dry scrubber that will run non-retrofitted diesel engine as power unit.

It is almost 5 years now that I don't have any contact with Dr. Olivier. Maybe, you need to email him about his current activities. Glad to hear it also!

With regard your questions about rice husk gasification to obtain blue flame, what I can share to you is all based on my studies and experiences in the past. Here they are below.

1. Rice husk contains high amount of ash (20%) which is crystalline white in color. 90% of the ash is silica and difficult to handle in any combustion devices. The volatile matter content is quite low of around 76% as compared with other biomass.

2. Gasifying rice husk is quite difficult to operate is a moving-bed gasifiers. The gasifier must be properly designed not to interfere the gasification zone during operation. When rice husk is use in fixed bed reactor, operation is very much stable. The only problem is if operation of more than 2 hours is required. Restarting between operation is inconvenience in this gasifier.
3. When gasifying rice husk, you can possibly obtain bluish colored flame as compared with other biomass. This is because rice husk exhibited low volatile mater as mentioned as compared with wood. However, not all the time when you gasify rice husk, bluish flame is present. I have rice husk gasifiers which produces pink to yellow flame and hardly can get the desired blue flame when operated.
4. The moisture content of rice husk when gasified also affects the color of the flame. When I use low moisture rice husk of around 10% and below, I can achieve a blue flame color. However, when rice husk is a little bit with high moisture say 14% and above. A pink colored flame usually appears
5. Air fuel ratio, superficial gas velocity, and specific gasification rate all affects the quality of gas from the gasifier. These all depends on the quality of rice husk used such as maturity, impurities, whether deteriorated or not, moisture content, etc.
6. The design of gasifier reactor and the burner also contributed in attaining blue flame color with rice husk as fuel. Properly design reactor having long but short diameter produces bluish flame. Also, when the reactor is insulated capable of increasing the bed temperature and injecting hot air to the fuel, blue flame appears. The burner design on the other hand can also affects the color of the flame. Burner that can eliminate tars before the gas and properly mixed with hot air can also produce bluish flame.
7. Torrefied rice husks or even some biomass can produce bluish flame in gasifiers. I did test runs during my visit to one Company in India and also in Vietnam that torrefied rice husks and other biomass produced bluish colored flame when gasified.
8. Completely carbonizing biomass like sugar cane bagasse before gasifying will not help enough to produce bluish flame when gasified. This is with the exception of wood with sufficient amount of carbon present after carbonization.
9. Bluish flame in gasified rice husk can also be obtained by wet scrubbing or simply by spraying the gas with water in an enclosed chamber. However, when scrubbing hot gas during the process can increase the O_2 content of the gas which results into reduction of the heating value of the gas. From around 1,200 kcal/m^3 gas, it will drop down to around 800 kcal/m^3 once scrubbed.
10. Therefore, if we really want to produce bluish flame from gasifier, what we need to do is to process first our fuel that has no moisture in it. Torrefied it if possible to remove part of the volatile matter that would not help in the combustion of gases. However, doing this will be costly unless the process can be integrated into the design of the reactor and the burner of the gasifier. For small systems like cookstove, this would be more quite difficult.

Again, thanks and God bless!!

Alexis