Anak Agung <agung589e@akprind.ac.id>

revise your manuscript submitted to IJHT

vivienne.liu <vivienne.liu@iieta.org> Thu, Mar 10, 2022 at 3:45 PM
To: agung589E@akprind.ac.id
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Dear author,

Thank you for contributing your paper to **INTERNATIONAL JOURNAL OF HEAT AND TECHNOLOGY**!

- Please revise your paper according to the attached comments.
- Highlight the revised parts in the final version of your paper and give a response according to review comments.
- Please typeset your paper according to template.

To ensure fast publication of your paper, please return your revised manuscript before **March 17, 2022**. Thus, we have enough time to process your manuscript in the next step. For further assistance, please do not hesitate to contact us via this email.

We would like to take this opportunity to thank you for choosing ***International Journal of Heat and Technology*** as your publishing medium and hope that we will receive further submissions from you in the future.

Best regards,

Ms. ***Vivienne Liu*** | Assistant Editor

vivienne.liu@iieta.org

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3 attachments

IJHT Template.docx
156K

IJHT-14216-comments.docx
18K

An effect of zeolite size on performance of dry scrubber in tarremoval of biomass derived syngas

Review comments:

1. This work aims to develop a simple and low-cost zeolite scrubber and investigate the effect of zeolite size on the performance of the scrubber for tar removal of syngas from biomass gasification. Is the innovation of this paper the synthetic method?

2. Please extract at least five keywords.

3. On page 2, for the text description "the after used liquid adsorbent is disposed to the environment without any treatment. This tar laden adsorbent may harmful to the environment. Thus, dry scrubber with solid adsorbent is developed and tested", please supplement references to support it, and it's suggested to highlight the importance of environmental protection.

4. Also in this paragraph, the text says "The concept of dry scrubber is similar to bed filter where solid material is used as filter bed. Bed filter is promising technology for hot gas clean-up which can be operated either in fixed bed, moving bed, or fluidized bed", then could the material in it be regarded as an adsorbent?

5. In the next paragraph on the same page, the text says "Syngas containing tar vapor (raw gas) enter the scrubber at high temperature (Tin). The syngas and tar vapor pass through the solid adsorbent whose temperature is lower than the gas temperature", have the authors considered the impact of high temperature?

6. In this research, the tests were performed by changing the diameter of zeolite (30, 40 and 50 mm), it's suggested to increase two diameters 35 and 45 for interval test analysis.

7. In section 2.1, the text says "The gas flow rate to the impinging bottles is measured using rotameter. The isopropanol containing tar is collected from the bottle and oven it at temperature of 50ºC for 2 hours. Isopropanol evaporates and tar remains. The remaining tar is then weighted to obtain tar gravimetric", have the authors considered the loss?

8. In section 2.2, "Once data of temperatures, pressure, and tar gravimetric are obtained, the performance of the zeolite scrubber is analyzed in terms of heat transfer rate, pressure drop along the scrubber, tar content of the syngas, and effectiveness of the scrubber", I suggest to add a filter layer to filter the tar.

9. In chapter 3, "…as shown in Figure 5. The average temperature of the syngas at inlet and outlet of the scrubber are 23.7, 19.6, and 17.3 ºC for zeolite diameter of 30, 40, and 50 mm, accordingly. Meanwhile the values of heat transfer are 15.5, 13.6, and 12.5 kW", the errors were not large, does it mean that the impact of diameter is small?

10. Figure 4 gives the temperature of the syngas at inlet and outlet of the scrubber, it's

suggested to put these charts together for better comparison.

11. On page 6, the text says “Figure 6 displays an effect of zeolite diameter on tar content after scrubbing and effectiveness of the scrubber. Tar reduction after scrubbing can be observed by comparing tar content before scrubber (TC1) and after scrubber (TC2). It can be interpreted that the highest tar reduction is achieved at zeolite diameter of 30 mm”, this summary is not accurate.

12. On page 7, “The size of the zeolite is proportional to specific area, heat transfer rate, and scrubber’s effectiveness as shown in Figure 7. When the zeolite size coarser, its specific contact area become smaller, hence heat transfer rate decreases in which reduces the condensation rate of the tar vapor that leads decreasing tar removal effectiveness of the scrubber”, I am totally agree with this result.

13. On page 8, the text says “From Figure 8, it can be stated cooling and scrubbing of the syngas occur less effective during the test. Several zeolite is still in white color after being used which indicated that cooling and scrubbing syngas is non-uniform in the scrubber. This may be caused by the syngas flows only over the top layer of the zeolite, thus the cooling and scrubbing occurs only on that layer. To overcome this phenomenon, the pressure of the syngas entering the scrubber should be increases”, such “non-uniform” phenomenon shouldn’t appear, it should be relatively uniform, please explain it in the text.

14. In the last sentence of the conclusion part, the text says “The highest effectiveness of the scrubber of 0.25 for the use of 30 mm zeolite adsorbent”, the control group is too small to fully illustrate the highest efficiency, many more comparative experiments should be carried out.

An effect of zeolite size on performance of dry scrubber in tar removal of biomass derived syngas

Detail Response to Reviewer's Comments

Dear Editor and Reviewer

Thank you very much for the review.

I have revised the manuscript (IJHT-14216) as per Editor's and Reviewer's comments and retype as per IJHT template. The revisions have been made are colored Blue in the Revised Manuscript. The detail response to the reviewer's comments are as follows.

Review comment:

1. This work aims to develop a simple and low-cost zeolite scrubber and investigate the effect of zeolite size on the performance of the scrubber for tar removal of syngas from biomass gasification. Is the innovation of this paper the synthetic method?

Response:

The innovation and novelty of the present work is the use of natural zeolite for tar removal of a producer gas from rice husk gasification. I have added this statement in novelty statement. The novelty statement becomes:

The present work proposes a zeolite dry scrubber for tar removal of syngas from biomass gasification. The work aims to develop a low cost and an effective natural zeolite scrubber and to investigate and effect of zeolite diameter on performance of the scrubber. The innovation and novelty of the present work is the use of natural zeolite for tar removal of a producer gas from rice husk gasification. No previous works have been reported on the use of zeolite scrubber in the area of gasification so far.

Review comment:

2. Please extract at least five keywords.

Response:

I have added one more keyword,

Effectiveness; gasification; scrubber; tar; zeolite

Review comment:

3. On page 2, for the text description "the after used liquid adsorbent is disposed to the environment without any treatment. This tar laden adsorbent may harmful to the environment. Thus, dry scrubber with solid adsorbent is developed and tested", please supplement references to support it, and it's suggested to highlight the importance of environmental protection.

Response:

I have cite the previous work to support tar effect on environment in first sentence of the paragraph. The additional information is as follows;

Generally, the after used liquid adsorbent, such as water, is required treatment before disposing to the environment. Tar is water soluble and create issues with waste water remediation in water [11]. The treatment of liquid adsorbent such as water need additional cost in producer gas clean-up process [12].

Review comment:

4. Also in this paragraph, the text says "The concept of dry scrubber is similar to bed filter where solid material is used as filter bed. Bed filter is promising technology for hot gas clean-up which can be operated either in fixed bed, moving bed, or fluidized bed", then could the material in it be regarded as an adsorbent?

Response:

Yes, it could.

The zeolite use for scrubbing act like adsorbent which adsorbs tar condensate. This is indicated by the zeolite's surface color which contact with the producer gas changes from white to brown. The change of zeolite color has been explained in last paragraph of Results and Discussion section. The discussion is

Meanwhile, Figure 8 displays photograph of the zeolite before and after being used. It is observed that zeolite surface color turns from white color before being used to brown color after being used.

Review comment:

5. In the next paragraph on the same page, the text says "Syngas containing tar vapor (raw gas) enter the scrubber at high temperature (Tin). The syngas and tar vapor pass through the solid adsorbent whose temperature is lower than the gas temperature", have the authors considered the impact of high temperature?

Response:

High temperature producer gas actually may impact the structure of the zeolite. However, this effect is not discussed in the present work, since the limitations of zeolite composition before and after used.

I have added this statement in the last sentence of the paragraph.

Review comment:

6. In this research, the tests were performed by changing the diameter of zeolite (30, 40 and 50 mm), it's suggested to increase two diameters 35 and 45 for interval test analysis.

Response:

Thank you very much for your valuable suggestion, In the future work, the test will be conducted at more variation of zeolite diameter and variation in flow configuration (parallel,

cross flow)

Review comment:

7. In section 2.1, the text says “The gas flow rate to the impinging bottles is measured using rotameter. The isopropanol containing tar is collected from the bottle and oven it at temperature of 50ºC for 2 hours. Isopropanol evaporates and tar remains. The remaining tar is then weighted to obtain tar gravimetric”, have the authors considered the loss?

Response:

I have not considered the loss.

I have added statement in the last sentence of the paragraph 2.1. …..During the investigation, it is assumed no losses of the producer gas flow from the reactor exit to the impinging bottle

Review comment:

8. In section 2.2, “Once data of temperatures, pressure, and tar gravimetric are obtained, the performance of the zeolite scrubber is analyzed in terms of heat transfer rate, pressure drop along the scrubber, tar content of the syngas, and effectiveness of the scrubber”, I suggest to add a filter layer to filter the tar.

Response:

Thank you for your valuable suggestion. I agree with you, a filter layer is required in order to increase the effectiveness of the scrubber. I have added the statement in the last sentence of Figure 6 discussion

Review comment:

9. In chapter 3, “…as shown in Figure 5. The average temperature of the syngas at inlet and outlet of the scrubber are 23.7, 19.6, and 17.3 ºC for zeolite diameter of 30, 40, and 50 mm, accordingly. Meanwhile the values of heat transfer are 15.5, 13.6, and 12.5 kW”, the errors were not large, does it mean that the impact of diameter is small?

Response:

In the present work, the zeolite diameter is relatively large. Thus, low heat transfer contact area between producer gas and zeolite. This mean that low heat rate, hence low temperature difference of the producer gas at inlet and outlet of the scrubber.

I have added this discussion in the paragraph of Figure 5 discussion. The addition are

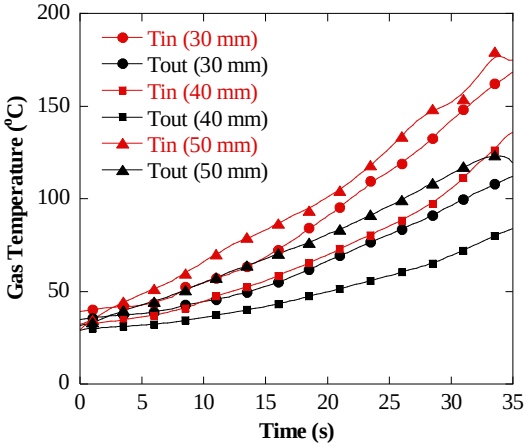
……The temperature difference of the producer gas at inlet and exit of the scrubber is relatively small. This is due to the diameter of the zeolite investigated in the present work is relatively large. Thus, low heat transfer contact area between zeolite and producer gas, in turns low heat transfer rate. As can be seen in Figure 6, the values of heat transfer are 15.5, 13.6, and 12.5 kW

Review comment:

10. Figure 4 gives the temperature of the syngas at inlet and outlet of the scrubber, it's suggested to put these charts together for better comparison.

Response:

I have pit the charts of Figure 4 together in one graph



Review comment:

11. On page 6, the text says "Figure 6 displays an effect of zeolite diameter on tar content after scrubbing and effectiveness of the scrubber. Tar reduction after scrubbing can be observed by comparing tar content before scrubber (TC1) and after scrubber (TC2). It can be interpreted that the highest tar reduction is achieved at zeolite diameter of 30 mm", this summary is not accurate.

Response:

More accurate results could be obtained by maintaining inlet temperatures of the producer gas same for all zeolite diameter. Thus, I revise the paragraph as

….. Regardless the effect of inlet temperature of the producer gas, the effectiveness of the scrubber declines significantly as diameter of the zeolite goes up from 30 mm to 50 mm. For the use of zeolite diameter of 30, 40, and 50 mm, the values of the effectiveness are 0.25, 0.17, and 0.13, respectively. However, more accurate result could be obtained by maintaining the inlet temperatures of the producer gas are same for all investigation…..

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Review comment:

12. On page 7, "The size of the zeolite is proportional to specific area, heat transfer rate, and scrubber's effectiveness as shown in Figure 7. When the zeolite size coarser, its specific contact area become smaller, hence heat transfer rate decreases in which reduces the condensation rate of the tar vapor that leads decreasing tar removal effectiveness of the scrubber", I am totally agree with this result.

Response:

Thank you for the agreement.

Review comment:

13. On page 8, the text says “From Figure 8, it can be stated cooling and scrubbing of the syngas occur less effective during the test. Several zeolite is still in white color after being used which indicated that cooling and scrubbing syngas is non-uniform in the scrubber. This may be caused by the syngas flows only over the top layer of the zeolite, thus the cooling and scrubbing occurs only on that layer. To overcome this phenomenon, the pressure of the syngas entering the scrubber should be increases”, such “non-uniform” phenomenon shouldn’t appear, it should be relatively uniform, please explain it in the text.

Response:

Thank you, I have added the explanation in the last sentence.

Review comment:

14. In the last sentence of the conclusion part, the text says “The highest effectiveness of the scrubber of 0.25 for the use of 30 mm zeolite adsorbent”, the control group is too small to fully illustrate the highest efficiency, many more comparative experiments should be carried out.

Response:

I revised the last sentence of the conclusion as

….. In the future work, more accurate result could be obtained by maintaining the same inlet temperatures of the producer gas for all zeolite diameter investigation.

Anak Agung <agung589e@akprind.ac.id>

Decision on your revised paper submitted to IJHT

vivienne.liu <vivienne.liu@iieta.org> Wed, Mar 23, 2022 at 10:19 AM
To: agung589E@akprind.ac.id

Dear author,

We have reached a decision regarding your submission to *International Journal of Heat and Technology*,

Manuscript Title: An Effect of Zeolite Size on Performance of Dry Scrubber in Tar Removal of Biomass Derived Syngas

Manuscript ID: 14216

Our decision is to: Accept Submission

Before we proceed with the publication of your article, please complete the arrange payment of your article processing charge (**US $ 450**) in 15 days by the following ways:

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If you have any questions, please do not hesitate to contact us.

Kind regards,

Ms. ***Vivienne Liu*** | Assistant Editor

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Anak Agung <agung589e@akprind.ac.id>

Decision on your revised paper submitted to IJHT

Anak Agung <agung589e@akprind.ac.id> Fri, Apr 1, 2022 at 12:45 PM
To: "vivienne.liu" <vivienne.liu@iieta.org>

Dear Ms. *Vivienne Liu*

Assistant Editor IJHT

I have transferred an amount of USD 450 for the Article Publication Charge (APC) of our accepted manuscript for publication in the International Journal of Heat and Technology.

Title: An Effect of Zeolite Size on Performance of Dry Scrubber in Tar Removal of Biomass Derived Syngas

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