



EIE-06-256 REEPRO



Promotion of the Efficient Use of Renewable Energies in Developing Countries

Training by Trainers level 2

Low cost gasifier Development

Report

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List of Content

1	Summary Sheet	2
2	Workshop Preparation	3
3	Workshop Performance	3
3.1	Presentation and discussion results.....	4
3.2	Discussion.....	6
3.3	Conclusion	6
3.4	Participants' evaluation	7
3.5	Programme	Fehler! Textmarke nicht definiert.
3.6	List of Participants.....	2
3.7	Photos.....	1

List of Figures

Figure 1	Evaluation results: strongly agreed.....	7
Figure 2	Not all Participants are sure.....	7
Figure 3	Participants feel neutrally.....	8
Figure 4	Participants' needs	8
Figure 5	Location of the low cost gasifier (inside the Mechanical workshop)	1
Figure 6	Observing the low cost gasifier at Mechanical Workshop (after classroom discussion)	1
Figure 7	Air tube, disappeared (melted) reactor tube and burnt mud surround.....	2
Figure 8	Burnt wood case	2
Figure 9	Discussion continued.....	2
Figure 10	Trainers visited cook stove production spot at Phakhao, Xaythany district, Vientiane capital.....	3

List of Acronymes

NUOL National University of Laos

Documentation of REEPRO level 2 Training by Trainers

1 Summary Sheet

Event: Training on low cost gasifier construction and modification

Task number

Date, Location, Time: 8.07.2009, 9:00-16.00
Mechanical meeting room
Faculty of Engineering, National University of Laos
Sokpaluang campus.
Friendship road. Vientiane. Lao PDR

Theme: Lesson learnt with Low cost gasifier construction

Target group: Mechanical Engineering students
 Installers

Performance: One session on lessons learnt and discussion

Participants: 11 participants,

Success: REEPRO trainers level 1 provided training on learnt lesson on low cost gasifier construction. Some fifth and fourth years students of Mechanical Engineering department have participated into one day training, which addressed problems in constructing low cost gasifier and possible solution.
Dr. Jan Kai Dobelmann from DGS showed problems, which were found while observing the constructed low cost gasifier. Then participants discussed on possible solution
The training was a cooperation between Mechanical department of Faculty of Engineering (NUOL) and REEPRO project

Download: The presentations can be downloaded under www.reepro.info

10 July 2009, Vientiane, Lao PDR



Dr Khamphone Nanthavong (Coordinator for REEPRO training level 2)

2 Workshop Preparation

- Arrangement:
 - REEPRO project provided training for mechanical engineering students on problems solving in constructing low cost gasifier, where the main construction materials used were mud, rice husk and used oil drums.
 - **Venue:** Training room and mechanical workshop, Faculty of Engineering, National University of Laos
 - **Date:** 08 June 2009
- Trainers and Trainees
 - The Trainers: level 1 Trainers of REEPRO project
 - The Trainees: fourth and fifth year mechanical students, who mostly have participated into constructing this low cost gasifier in November 2008.

3 Workshop Performance

- The training started by remark on objectives of the training and it's flow, by Dr. Khamphone Nanthavong, REEPRO project training coordinator in Lao PDR.
- Then Dr. Jan K. Dobelmann (DGS president, REEPRO expert) presented the problems, which were obtained during observing the constructed low cost gasifier. Then the participants discussed possible solution for each problems, one by one;
- The presented problems and discussion were connected to the following matters:
 - Gasifier components (fuel feeder, reactor, ash trap, gas cooler)
 - Construction materials (mud, rice ash and husk, metal sheet, air feeding tube, suitable proportion of mud-rice husk-water, etc)
- These problems solving will serve as good ground for students' research
- A group of three fourth year students were assigned to do design modification of the gasifier and to rebuild it

3.1 Presentation and discussion results

Gasifier parts	Problems	Possible reasons/solutions/ideas
Overall remarks	- wood case of the gasifier got fire.	- The reasons probably due to leaking of hot flammable gas and got fire when met air. The mixed mud-rice husk environment was not airtight due to incorrect proportion of mud-rice husk: too much of rice husk were put into mixture. - Solution: to find out appropriate proportion of mud-rice husk in order to get airtight layers, but to serve as a good insulation material at the same times
>>	- large amount of water (~10 L) collected in the ash trap tank - 3-4 pieces of chicken egg size of burned mud (became as hard as brick) were found at the bottom of the reactor and in the passage of the gas into ash trap tank	- The cone was not firmly welded so that mixed water-mud (liquid mud) could flow through these ways down into reactor and ash trap due to contained too much water. Some mixture of mud-water flowed down into the reactor during the operation, getting hot and burned, but most water flowed down to ash trap tank and collected there - Solutions: a) firmly welded the cone and reactor b) put less water while mixing the mud-rice husk materials
>>	- the wooden case was partly burned	- Wood is flammable - the outsider case can be built of inflammable materials, such as bricks/ cement blocks/clay blocks/...
Reactor	- the surrounded gas reactor mud was burned out and has become hard brick	- this shown right direction in using mud to surround the metallic reactor and also indicated rather high reaction temperature - Mud+black rice ash mixture is suitable material for constructing gasification reactor

<p>Reactor</p>	<ul style="list-style-type: none"> - melted metallic reactor tube (metal tube thickness of 1 mm) 	<p>Reason: this is due to rather high temperature (800-1000 °C) and aggressive environment in the reaction zone;</p> <p>Solutions:</p> <ul style="list-style-type: none"> - the reactor would be made of mud+rice ash (black) tubes - there is possible to prefabricate short mud-rice ash tubes and then to assemble into longer reactor tube - bamboo or any other easy burning material tube with appropriate size can also be used for moulding mud reactor
<p>Reactor</p>	<ul style="list-style-type: none"> - melted grate 	<ul style="list-style-type: none"> - reason as above: high temperature and aggressive environment - there is suggested to use burned mud+black rice ash grate, like those using in improved cook stoves;
<p>Connection</p>	<ul style="list-style-type: none"> - Air leakage in connecting points leaded to burning out the rice husk, which were the components in insulation materials and then the wooden cover case; - The leakage happened at the junction points between (1) reactor-output tube; (2) Output tube-ash trap tank; (3) connection between Ash trap-cooling tanks; 	<ul style="list-style-type: none"> - the mud tube must be carefully covered by well-mixed mud-rice ash, slowly layer by layers; - the junction points must be carefully covered by well-mixed mud + rice ash, slowly layer by layers; - the connecting tube may be prefabricated - The ash trap and gas cooling tanks can also be made of concrete tank or be constructed by brick-cement structure;
<p>Fuel feeding cone</p>	<ul style="list-style-type: none"> - inside-cover metallic sheet of the cone was nearly gone, especially lower zone 	<ul style="list-style-type: none"> - lower part of the cone is close to hot reaction zone; - actually, there is not necessary to use metallic, just any proper cone shape of Mud-Rice husk can be used instead; - The fuel cone tank can be carefully built by using bricks or mud blocks - The cone mould can also be made of thin galvanized steel, which is easy for bending and connecting, then to cover from outside with mixed mud-rice husk (with less water put in)

Gas blower	- the blower got hot while operating	- hot gas from the ash trap tank entered to the gas cooling tank was not fully cooled down, - Some suggestions on this issue: to put cooling water jacket surrounding the gas cooling tank; more intensive cooling through welded fines; more passages inside the cooling tank; etc...
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3.2 Discussion

- The lessons learnt from the constructed low cost gasifier can be serve as a good ground for further research activities at the Mechanical Engineering department of the Faculty of Engineering (NUOL)
- Further study and development research are necessary in order to get more understanding on gasification technology and to start its application in our country
- A group of 3-4 fourth year students of Mechanical department has had interest to go for further development of this gasifier. Their research results can be serve as their graduation thesis
- The trainers visited the cook stove production spot of Mr. Vanna Typanya, Phakhao village, Xaythany district, Vientiane capital to find out the right proportion of Mud-rice ash mixture and suitable grate materials

3.3 Conclusion

- The training was quite useful even. Although the training was shortly happened but many things have been discussed and learned;
- The constructed low cost gasifier has excited staffs and students to do more development research;

3.4 Participants' evaluation

Totally 11 fourth and fifth years students of Mechanical department attended the training. Evaluation results of them are as followed:

- Almost all participants agreed that the training meets their expectation and was practical enough. Would the help of the trainers the students have had better understanding on gasification principle and could learn how to design a low cost gasifier

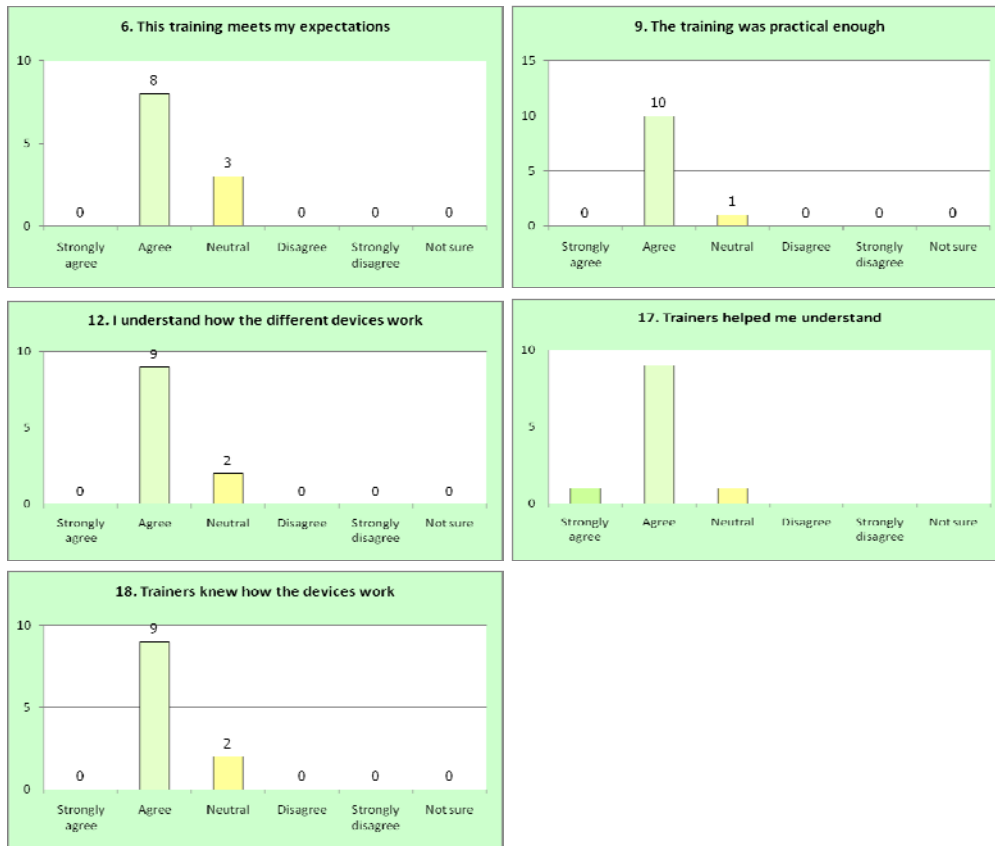


Figure 1 Evaluation results: strongly agreed

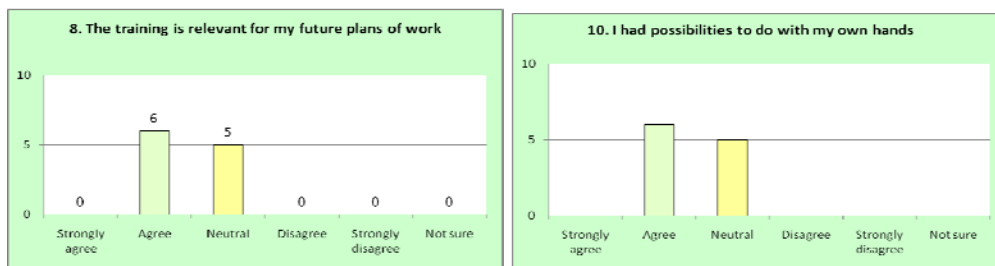


Figure 2 Not all Participants are sure.

- While participants were not really sure if the learned experiences would be relevant to their future work or not, that if they could do by themselves or not

- Major trainees have feeling neutrally on such topic as relevance of the training contents to their future work, how to install the devices, further training needs on rocket stove construction, duration of the training and appropriate of provided training materials.
- Mostly participants expressed that to gain knowledge was their main reason to participate the training and they would like to have additional topics of the training

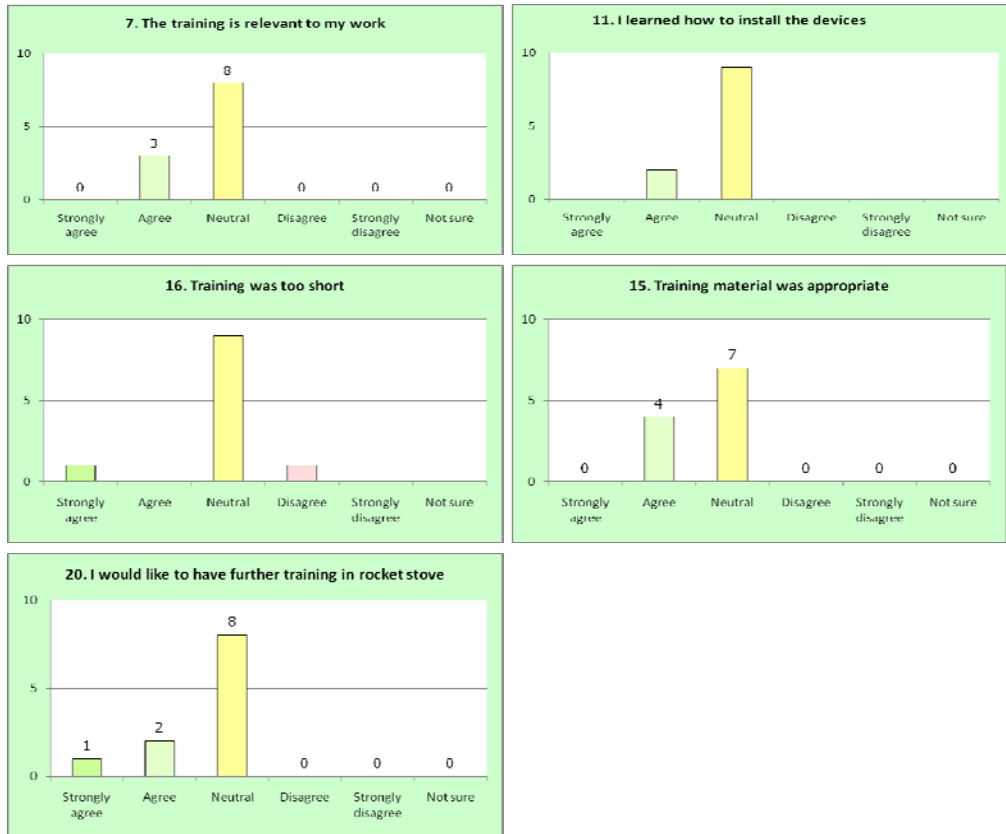


Figure 3 Participants feel neutrally

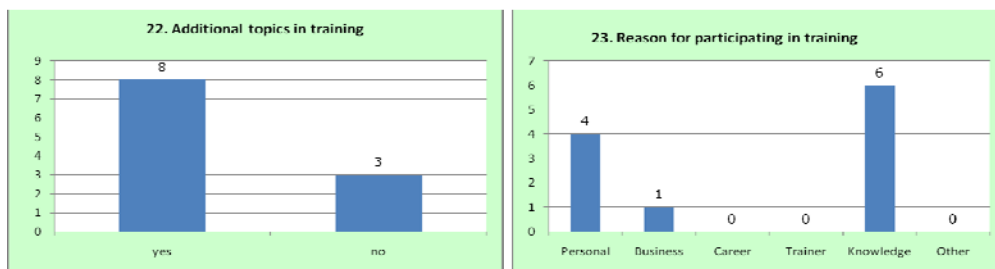


Figure 4 Participants' needs



EIE-06-256 REEPRO



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**One day Training by Trainers Level 2:
Low cost gasifier Development from lessons learnt
Faculty of Engineering
9 June 2009**

Tentative schedule

Author

Khamphone NANTHAVONG, Faculty of Engineering (NUOL)

June 2009

Tentative schedule

Targets: Fourth and five year students of Mechanical Engineering department

Venue: Mechanical meeting room

Date: 09 June 2009

ID	Topics	Trainers in charge	Time
	Objectives of the training	Khamphone	9:00-9:15
	Presentation and discussion on the problems, observed from the constructed low cost gasifier	Kai Debelmann + Khamphone	9:15-11:15
	Lunch Break		12:00-13:00
	Gasifier observation by the trainees and Discussion continued	Kai Debelmann + Khamphone	13:00-14:00
	Sightseeing to the cook stove production spot	Kai Debelmann, Khampha and Khamphone	14:00-16:30

3.5 List of Participants

Name of participants	Organization	E-mail
1. Mr. Mayang	5y Student	Mayaj56@yahoo.com
2. Mr. Bounthavy Souvany	5y Student	
3. Mr. Syvay Chanthavong	5y Student	
4. Mr. Lattanavong	5y Student	
5. Mr. Soulivanh	5y Student	
6. Mr. Khomsavanh	5y Student	
7. Mr. Xayalak Vilaida	5y Student	Xayalak_vilaida@yahoo.com
8. Mr. Sengphayvanh	4y Student	
9. Mr. Sengdao	4y Student	
10. Mr. Khamdee	4y Student	
11. Mr. Chanthi	4y Student	

3.6 Photos



Figure 5 Location of the low cost gasifier (inside the Mechanical workshop)



Figure 6 Observing the low cost gasifier at Mechanical Workshop (after classroom discussion)



Figure 7 Air tube, disappeared (melted) reactor tube and burnt mud surround



Figure 8 Burnt wood case



Figure 9 Discussion continued



Figure 10 Trainers visited cook stove production spot at Phakhao, Xaythany district, Vientiane capital.

Found Facts: Mixture of Mud and black rice ash (rice charcoal) with appropriate proportion can be used for making reactor tube, grate and connecting sealant materials