

## Visit to Kunming, China During 22-28 July 2006 to conduct Gasification Training

Prof. H. S. Mukunda and Dr. C. S. Bhaskar Dixit were invited by ARECOP (Asia Region Cook Stove Program) to conduct a training on Gasification based Combustion Devices for Small Scale Thermal Applications at Kunming, China. The Training modules were designed and executed by Prof. H. S. Mukunda and Dr. C. S. Bhaskar Dixit. The training is followed up by ARECOP funded projects to be carried out by participants during August 2006 - July 2007. The results of the projects will be presented in next meeting likely to be held in Bangalore during 2007.

The participants were from India, Indonesia, Laos, Thailand, Nepal, Sri Lanka, Philippines, China and USA.

### A brief Report follows:



A. Group photo. B. View of room in which training was conducted. Prof. Xia Chaofeng, (Director of SERI, YNNU, Kunming, China) is seen inaugurating the training.

### PARTICIPANTS:

Rows (Left to right) from front to back in group photo

1. Chinese Interpreter, S. Woranuch Jangsawang (Thailand), Aryanto Sudjarwo (Indonesia)
2. Shea (China), Prof. Xia Chaofeng, (Director of SERI, YNNU), Belenio (Philippines), Bulathgama (Sri Lanka), Erwan (Indonesia), Houmpheng Theuambounmy (Laos)
3. Pu (China), Edwin (China), Soukanh Vannapho (Laos), Vanna Tipangna (Laos), Hermanto Sudjarwo (Indonesia), Abdul Shakoor Sindhu (Pakistan), Prof. H. S. Mukunda (India), Dixit (India)

4. David (USA), Rajan Thapa (Nepal), Dean Still (USA), Dang Tanoewiangga (Indonesia), C. K. Kumaraswamy (India), Paul Anderson (USA)
5. Neelesh Koul (India) came after this photo session (held after introductory session).

## **SCHEDULE:**

**Day 0:** Discussion with ARECOP concerning the schedules to be followed for the training

**Day 1: 23-08-2006:**

Prof. Mukunda's presentations  
Discussion.  
Dixit's Presentation  
Discussion.

**Day 2: 24-08-2006:**

Prof: Mukunda's presentations  
Expert consultation with Soukanh Vannapho, Vanna Tipangna, and Houmpheng Theuambounmy (Laos), Rajan Thapa (Nepal) and Bulathgama (SriLanka) for calculation procedures.

**Day 3: 25-08-2006:**

Presentations from Belenio, Anderson and Dean Still and discussion.  
Visit to Mr. Hao's gasification factory  
Expert consultation with Kumaraswamy (India) for calculation procedures

**Day 4: 26-08-2006:**

Expert consultation with Indonesian participants for calculation procedures  
Expert consultation with Thai participant S. Woranuch Jangsawang for calculation procedures.

**Day 5: 27-08-2006:**

Presentations from 5 participants based on inputs given during consultations provided earlier.  
Visit to Two local villages to see biogas stoves.

**Day 6: 28-08-2006:**

Presentation from remaining 3 participants  
Description of reporting format requirements by Aryanto  
Expert Summary by prof. Mukunda

## PROJECTS:

1. Professor Alexis Belonio of the Philippines will focus on the possible application of the "steam box" in the combustion area of the "conical grate" rice husk stove.
2. Bulathgama of Sri Lanka proposes a gasifier project to work with a very large pineapple fruit drier that currently runs on 7.5 liters of kerosene per hour for 20 hours per batch, so it is very costly as currently operated. The process heat must go to a heat exchanger (only clean hot air can have contact with the fruit) that is with small passageways, resulting in concerns about blockages if anything except clean gas is burned. The recommended gasifiers are either Belonio's large, two chambers plus cyclonic filters if rice husk available and is economical or downdraft Gasifier with full filtering (as is needed for running IC engines), at a cost of about US\$15,000 to \$18,000. Even at the \$15K price, the pay-back period is something like 6 months or less. Bulathgama will be working closely with the manufacturers of the driers.
3. Abdul Shakoor Sindhu of Pakistan is looking to have relatively small reverse downdraft gasifiers to provide the heat for the tandoor (tandoori) ovens that are used to bake roti and other things.
4. C. K. Kumarswamy of Bangalore, India, is focused on the relatively large cookstoves of the roadside restaurants. High heat is needed for several hours at 3 meal times per day. Fuel consumption currently is about 3 kg of wood per hour per stove (One pot per stove). Some form of reverse down draft cook stove is to be used.
5. From two different cities (500 km apart) in Indonesia, Dang Tanoewiangga and Hermanto Sudjarwo are interested in two food products made from palms. Both products involve boiling away the water. One is to make palm oil from palm sap collected from the trunks of some palm trees. The other is to make coconut brown sugar from the juice of the white coconut meat (copra). These use round-bottom pots of about 30 - 40 liters, and are stirred almost constantly to evaporate about 24 kg of water, leaving about 6 kg of oil. Reverse downdraft gasifiers with fuel chambers of 20 cm Diameter x 70 - 90 cm Height (or 30 cm D x 50 - 70 cm H) are recommended for the approximately 4-hour process that currently uses about 2 kg of wood per hour.
6. Rajan Thapa of Nepal explained the seasonal production (Dec to March) of Lapsi candy made from fruit. The 100 liter pots (half-barrel of 55 gal drums) need to come to a boil and then simmer, for a total of 2 hours.

7. Ms. Woranuch Jangsawang of Thailand is to deal with institutional cooking at a large temple near Bangkok. About 500 people are served at each of two meals every day. Multiple large pots are used now with LPG as the fuel. Not all of the temples are that large, but there are 34,000 temples in Thailand, so a biomass gasifier solution to the situation could be widespread and would be seen by millions who obtain some of their education at the temples.
8. Participants from Lao (Laos) are Soukanh Vannapho, Vanna Tipangna, and Houmpheng Theuambounmy. They have the application with the largest amount of heat required. In landlocked Laos, salt is produced from brine (salt water) brought from deep wells. 132 production units (with 2 workers at each one) are shallow metal trays with a fire running under each one to a chimney, for 8 to 10 hours each batch, some working two batches per day. Each one needs 360 kg per day of wood, 240 kg per day of sawdust, or 480 kg per day of rice husks.

**ACTION:**

For each of the eight applications, the participant is to verify the data and methods about the processes involved, make adjustments, and correspond with the ARECOP office and with Prof. Mukunda. Designs and technical drawings are to be submitted for review and possible revisions within a couple of months. Then gasifiers will be constructed and field tested.