PADDY HUSK/SAWDUST FIRED INDUSTRIAL STOVE

ITDG
PRACTICAL ANSWERS TO POVERTY

technical brief

Background

Currently two types of industrial stoves are used for open pan heating purposes in local industries. They are:

- A stove constructed out of brick that uses firewood as an energy source. This type of stove could have an ash pit and iron grill, but it is not compulsory.
- A gas stove (LPG gas) with several firing rings.

The stove introduced by ITDG South Asia, is soot free (smoke free) and uses cheaper energy sources (paddy husk, sawdust) that are also a waste product from other industries. It can be used in any common heating operation: such as open pan boiling, heating, evaporating, crystallisation, frying, roasting etc.

The Stove

This industrial stove requires only a slight modification of the traditional paddy husk/sawdust stove. It has a set of stove-tops that receive direct heat (primary stove tops) and a third stove top (e*conomiser* or a *flue gas recovery stove)* that will recover heat from the flue gases generated from the primary stoves. This not only re-uses the heat but also increases the efficiency of the energy conversion ratio.

The stove can be converted into one that uses firewood as fuel source if required.

Advantages of this stove are that it

- Uses waste as a fuel source (paddy husk and sawdust)
- Is low cost
- Has simple construction
- Has low maintenance requirements
- Is smoke and soot free and therefore suitable for any type of food preparation
- The economiser stove top re-uses the heat generated from the primary stove tops
- Is easy to operate

Technical details

Materials Required

Material	Amount
Clay Bricks	1000 nos.
Fine grain river sand	¼ cubes
Fine grade clay	¼ cubes
Paddy Husks ash (white)	60 kg
Rubble (granite 9 inches)	¼ cubes
Empty tar barrel - 48 cm in diameter	2 nos.
Wood poles or PVC Piping (120mm in diameter and 1m in length)	5 nos.
Mild steel 22G tubing (for chimney)	1 nos.

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Construction
Please refer the drawings.

The main structure

- The clay, fine sand, paddy husks and ash are mixed with water and kept aside for at least one week before the stove is built.
- Rubble masonry foundation is laid and the walls of the stove is built from the clay bricks using the above mixture.
- Special care must be taken when building the inner walls of the arches of the primary stoves. The flue gas paths too should be built with care and precision.
- The surface of the stove, after the bricks are set, should be paved with the clay, sand, ash mixture.
- The stove has to be left to dry for 15-20 days before it can be used.

Stove Tops
Primary Stove Tops
These two stovetops will be placed at ground level. The stovetops will be two circular structures (250mm in diameter) consisting of a layer of bricks paved with clay. These stove tops will have the tar barrels (converted into hearths) placed below it (underground).

Economiser stove top
This stovetop is 500mm in diameter and will have a height of 250mm from ground level and this too is constructed with bricks and clay mixture. It is positioned in the centre and has a curved layer of bricks from below ground level to the top of surface.

The Hearth

- Two semicircular openings of 130mm diameter are cut in the bottom of the tar barrel.
- Two hooks/handles can be attached to the top of the barrel to help with easing the barrel into position. The top edges of the barrel have to be smoothened and rounded. The two barrels will be placed under the two primary stove tops (below ground level).

Specific Requirements
The stove needs a floor area of around 8 -10 m^2.

Capacity

- It is possible to boil 800 - 1000 lt. of water on the primary stove tops and heat (upto75°C) 400 - 500 lt. of water on the economiser stove top at one time. The amount of fuel needed for this task is 30-35kg of sawdust or paddy husks.
- Studies show that 13.5 kg of LPG (1 gas cylinder) is required to heat 1000 lt. of tomato juice. The cost of a gas cylinder is Rs. 315.00 (price as of 31 December 1997). When using the paddy husk/sawdust stove for the same purpose the energy requirement is 35 kg (2 bags) costing Rs. 30.00.

Operations

The Hearth

- Two wooden poles or pipes are inserted through the holes cut at the bottom of the tar barrel. The poles are inserted to make a “V” shape. Three more poles are placed vertically on top of the poles at the base (See Diagram).

- Slightly dampen the sawdust/ paddy husk and put it into the tar barrel (fill about a quarter of the barrel). The sawdust or paddy needs to be compacted well by using your feet or a suitable wooden pole. If the sawdust gets too dry, sprinkle with water. This procedure is repeated until the barrel is filled with sawdust/paddy husks.

- Once the sawdust/paddy husks have been well compacted the cylinders that were inserted can be removed. If the pathways are clogged, the excess sawdust/paddy husks have to be cleaned out.

- A little kerosene or a similar substance can be sprinkled into the *pathways* that were formed after removing the cylinders from the barrels before they are placed under the stovetops. This helps the stove to light faster. A dry piece of firewood to be placed inside the pathways for this purpose.

- Lighting the hearth is done only after all three stovetops have been covered. The hearth needs to be pulled out every time a stovetop is uncovered.

- If one stovetop is not being used it has to be covered with a steel plate while operation.

Maintenance

The stove needs to be cleaned after use – all ash must be removed.

Cost

• Cost of Materials	Rs. 3000.00
• Cost of Labour	Rs. 2000.00
Total Cost	**Rs. 5000.00**

Note: The total cost may vary depending on the location and availability of materials, transportation etc. It could be estimated that the cost would be between Rs. 5000.00 and Rs. 7000.00.

References and further reading

- *Institutional Stoves*, ITDG Technical Briefs
- *Improved Wood, Waste and Charcoal Burning Stoves: A practitioners' Manual* by Bill Stewart et al. ITDG Publishing, 1992, ISBN 0 946688 65 6
- *Sawdust Burning Cooker*, Boiling Point No 3, ITDG, 1982
- *Sawdust Utilization, Experience in Mutare, Zimbabwe*, Boiling Point No 39 – Using Biomass Residues for Energy, ITDG, 1997

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For further information and engineering drawings