**Introduction**

This is a support document that supplements the reference document “How To Build An Efficient Wood Burning Stove” revision 07/16/2013. This supplement (1) shows how to make the pumice, slabs, housing brick and combustion chamber pieces for the reference document.

**Processing Pumice**

The Sumbawanga stove building team has access to an adequate supply of natural pumice in the region of Mbeya (Runguwe volcanic complex). The naturally occurring pumice may contain fine volcanic sand, clay minerals and silts that are heavy and unsuitable for making light weight pumice bricks. The natural pumice should be mixed thoroughly to obtain a uniform particle size distribution. Then remove particle sizes less than 1.0mm by using a fine mesh screen (18x18) (screen openings .98mm). The screen openings are similar to the openings in mosquito netting. See Figure 1 and Figure 2 for a method of removing this material by flushing water through the natural pumice. Figures 3 show the water separated from the silt. Figure 4 show the removed silt, fines and clay minerals that has been removed from the natural pumice. The water left over could be reused if water is scarce.

The pumice that has been screened will be ideal for making pumice brick. Larger pieces of pumice, greater than 10mm need to be crushed to smaller sizes. Add the crushed material with the fines to the screened pumice and mix thoroughly.

The particle size for the loose pumice insulation around the combustion chamber can be as large as 20mm
FIGURE 1- REMOVING SILT AND FINES FROM PUMICE

FIGURE 2-SCREEN SIZE 18X18 TO REMOVE FINES
FIGURE 3- WATER AND FINES REMOVED FROM PUMICE

FIGURE 4- REMAINING SILT AND FINES REMOVED FROM PUMICE
Making Pumice Bricks
The pumice should be saturated after the screening operation but excess water should be removed see Figure 5. The mix ratio should be (six parts of pumice one part cement) by volume and mix until the cement is uniformly distributed. Then add water gradually to the mix to obtain a uniform stiff consistency Figure 6. The amount of water depends on the saturation level of the pumice after screening, be careful when adding water. Remember the stiffer the mix the stronger the brick. To check for a stiff consistence, take a handful of the pumice mix and squeeze the pumice mix and it should extrude and not be dry see Figure 7. When finished mixing fill the mold half way see Figure 8 and compact (tamp) see Figure 9, then fill the mold and tamp again, but not excessively, just enough to compact the pumice mix in the mold and fill voids.

Following is how to calculate the pumice cement mix; if the mold volume (length X, width W, height H,) is 9000 cubic centimeters (example) multiply the volume by .001 to obtain liters. That would equate to 9 liters of pumice. Dividing 9 liters by 6, you would need 1.5 liters of cement. Note: the volume of pumice is equal to the volume of the mold plus extra for compaction of the loose pumice.

Note: The pumice used for the prototype herein is from a product called Dry Stall (USA) and it will look different then the natural pumice from the Runguwe volcanic complex but the processing will be the same.

Brick Molds
Molds are made of wood to shape the bricks (blocks) for the outer housing, support slabs, combustion chamber and internal wall see Figure 11. The molds need to be stiff to hold the shape of the blocks and are held together with screws for disassembly. In the future where many stoves are required, special molds can be designed using aluminum or steel. The dimensions for the brick molds are in the stove building document. The molds need to be made with square corners with accurate designed dimensions. Molds need to be greased, see Figure 12 and 13, so the blocks can be removed from the molds by backing off on the screws without damage to the blocks. Figure 14 is the mold for the outer housing brick and Figure 15 is the stove support slab showing placement of the bamboo stiffening before covering with the final layer of pumice cement mix.
FIGURE 5- DRAIN AND REMOVE EXCESS WATER FROM PUMICE

FIGURE 6- MIXED PUMICE CEMENT AND WATER
FIGURE 7 - STIFF PUMICE CEMENT MIX

FIGURE 8 - PLACING PUMICE CEMENT MIX IN A MOLD
FIGURE 9 COMPACT (TAMP) PUMICE CEMENT MIX

FIGURE 10 PLACING BAMBOO STIFFENERS
FIGURE 11-STACK OF BRICK MOLDS FOR STOVE BUILT IN USA
FIGURE 12-GREASING WOOD FRAME MOLD

FIGURE 13-GREASING SLAB MOLD BACKING BOARD
FIGURE 14-HOUSING BLOCK MOLD SCREWED TOGETHER

FIGURE 15- PUMICE SLAB WITH BAMBOO STIFFENERS
Combustion Chamber Mold
The mold for the combustion chamber (CC) side block is shown in Figure 18. Figure 19. The spacer piece held by 2 screws is for the opening required for placement of the Tuffloor lining that wraps around the top of the combustion chamber blocks. All the inner surfaces of the combustion chamber are lined with Tuffloor manufactured by Allied Mineral Product from South Africa outside of Johannesburg. Figure 20 shows the pumice cement mix placed in the mold where the wood spacer is being removed to provide a space for the Tuffloor lining and Figure 21 show the Tuffloor being placed where the spacer was removed. Figure 22 show the placement of the Tuffloor lining and Figure 23 shows the completed CC side block. The reaming blocks are fabricated in a similar manner.

FIGURE 18- WOOD FRAME FOR COMBUSTION CHAMBER
FIGURE 19 - ADDING PUMICE CEMENT

FIGURE 20 - REMOVING SPACER FOR TUFFLOOR LINING
FIGURE 21-ADDING TUFFLOOR LINING

FIGURE 22- ADDING TUFFLOOR LINING
FIGURE 23- COMPLETED SIDE BLOCK OF COMBUSTION CHAMBER

Stove Pipe Insert in Housing Brick

Figure 24 and 25 show the chimney stove pipe insert in the aft wall upper section that consist of two pumice bricks, each with a square opening for the pipe insert. The opening provided around the stove pipe is square need to be filled with Tuffloor or pumice cement. A short section of stove pipe is required for inserting the elbow piece. This is necessary to provide a method for removing stove pipe for cleaning
FIGURE 24- STOVE PIPE INSERT IN HOUSING BRICK

FIGURE 25- STOVE PIPE INSERT WITHOUT ELBOW
Another brick mold for information only

Here are two picture of a brick mold (backing board not shown) I used on earlier prototype stoves, it worked well. It has one hinge, alignment pin and a hook and eye on one side and is fastened with nails or screws at the other side. When the hook is released and the alignment pin removed the mold opens enough to release the brick.

(The notch has no significance)
Things to remember

- The brick molds should be oiled, greased or painted to provide a nonstick smooth surface see Figure 12 and 13. Note; the backing board is part of the brick mold and needs to be treated.
- The brick mold surfaces in contact with the pumice should be damp, not wet, prior to adding the pumice mixture. Mop up excess water with a dry rag or sponge.
- The brick mold needs to come apart. In a normal brick mold, the clay brick can slide out of the mold but this is not the case with pumice brick. See Figures 14 where the wood molds are screwed together and can come apart by backing off on the screws.
- After 3 or 4 hours slowly slide the mold on the backing board laterally to break the bond between the mold and the backing board. If there was a stiff pumice cement mix the outer mold can then be removed carefully or wait till the next day.
- The brick should remain on the backing board of the mold for several days before moving them to a level surface for storage. At this stage handle the brick carefully to avoid breaking off their edges. It takes the bricks at least 2 to 3 weeks to gain strength.
- The stored bricks must stay out of the sun and rain. Cover them with a damp cloth or leafy branches, if possible so they will not dry out too quickly.
- The precast bricks and slabs need to dry for four weeks before assembly or applying stucco.