For example, this **17L** drum/ combustion chamber

- **17L** of vermiculite
- 2890 g of cement and
- 4930g of water

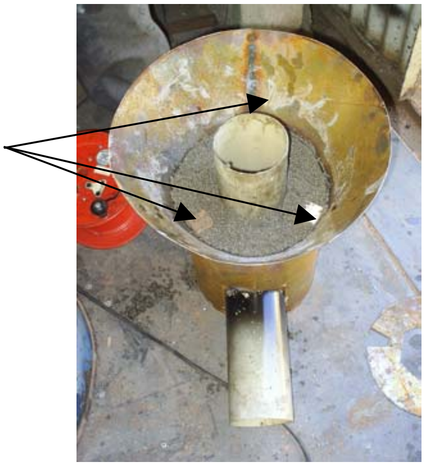
Mix the above ingredients and then…

Lightly fill the bottom 5 cm of the drum with the cement vermiculite mixture. Do not tamp

Insert the oiled 125mm (or, if not available, 110 mm) PVC pipe

There should be sufficient mixture to completely fill the drum. If not, it means that the mixture was tamped with too much force. Empty out the contents and repeat the process using less force.

Place three $4cm^3$ blocks of wood inside the combustion chamber as shown. They should be flush with the top of drum and set 120° from each other.



These will create a slot/opening for the pot legs to sit into. Let the mixture set overnight or for 8-12. hours, and then remove the blocks from the insulative mixture

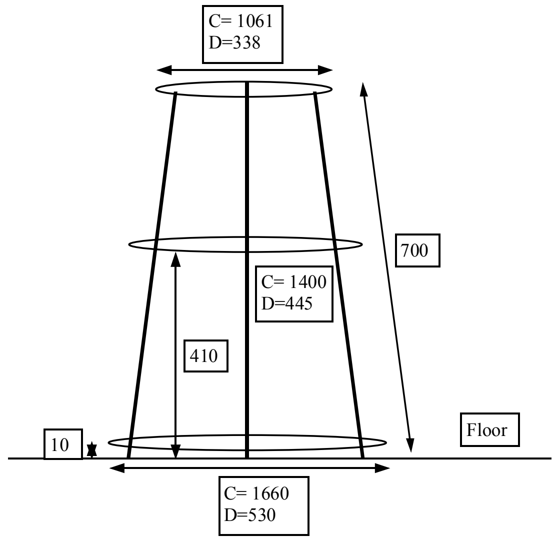
Place the top plate/insulation cover inside the cone and on top of the combustion chamber. Tack weld the top plate to the cone and then remove the PVC pipe.

Make slurry of one part cement to 3 parts water. Use this slurry to thinly coat the inside of the entire combustion chamber.

Cut three 200 mm pieces of 16 mm round bar. Score them 50 mm from the tip and bend to fit inside the cone. Then tack weld in place at 120 degrees.

Then paint with red oxide. Allow to dry. Then coat with flat black enamel

<u>Building the stand</u>
Rings 10 mm round bar
Legs 20*20*1.6 mm square tube



Shown here is the removable shelf that rests on the center ring. This design component will be changed in future models. Instead of having a removable shelf that spans from the combustion chamber to the support ring, the shelf will now be smaller and fixed to the combustion chamber. The shelf will be made from 3mm mild steel and will be similar in shape to the shelf in the Mozambican single pot stove. This design modification will decrease the possibility of shelf misuse, increase the shelf's longevity, and reduce the price of the stove.

The middle ring, that now supports the shelf, will remain to support the wood in the proper position.

6.0 The Household Nkokonono MK3

(6 Brick VIC combustion chamber)
Due to the higher costs associated with firing the VIC bricks, it will be preferable to use the cement vermiculite mixture that doesn't need to be fired.

6.1 The Household Nkokonono

The Way Forward

We need to produce a number (perhaps 5-10) of the new cement vermiculite household Nkokononos to assess their durability.

The pricing of the Nkokonono house needs to be reassessed, as ATS wants to sell the stove for 380 Rand! Here is the price list from ATS:

Nkokonono household stove with stand

Material		Cost (M)	No. required	Total cost
1225 x 2450 x 1.6mm	sheet HR	333.54	0.32	106.73
10mm Dia.	Bar (6m)	23.14	0.74	17.12
20 x 20 x 1.6	Square tube	52.68	0.4	21.07
9Kg Vermiculite		50	0.2	10.00
50Kg Cement		60	0.06	3.60
Overheads		15%		23.78
			TOTAL	**182.31**
			Manufacture time in days =	**1.00**

Labour charge (M10/hr) =	**80.00**
Subtotal	**262.31**
Business Profit (10%) =	**26.23**
Total	**288.54**
Sale price	**310.00**

In my opinion ATS has overestimated the price of the stove . Here are my estimates.

Nkokonono household stove with stand

Material	**Cost (M)**	**No. required**	**Total cost**
1225 x 2450 x **1.6mm** sheet HR	190	.25	47.5
10mm Dia. Bar (6m)	23.14	0.74	17.12
20 x 20 x 1.6 Square tube	52.68	0.4	21.07
9Kg Vermiculite	50	0.2	10.00
50Kg Cement	60	0.06	3.60
Overheads	15%		23.78
		TOTAL	**123.31**
		Manufacture time in days =	**.30**
		Labour charge (M10/hr) =	**30.00**
		Subtotal	**153.31**
		Business Profit (10%) =	**15.3**
		Total	**168.61**
		Sale price	**168.61**

7.0 The Nkokonono Poloko

Constructing the Nkokonono #25.
These photos accompany the AutoCAD drawings that are attached to the bottom of this word document




08/27/2003


08/27/2003

The three #25 stoves that were placed with WFP were made with fired VIC brick combustion chambers. These bricks are durable but they have a number of drawbacks. . They are expensive, heavy and complicated to produce. The new cement vermiculite bricks do not have these drawbacks but their durability still needs to be assessed. . The cement vermiculite bricks should be mortared together with the same mixture as the VIC bricks: a mixture of 1 part cement, 1 part cement and 1 part vermiculite.

7.1 Nkokonono Poloko #20

This stove uses the same combustion chamber as the #25 but uses a recycled drum for the body of the stove. This stove is simpler and cheaper (300Rands material cost) to produce than the #25. We still need to monitor the functionality of the #20 stove that was disseminated during phase 1 to St Philomena Primary School. Our first priority is to have Andres Michel visit the school to gather feedback on the stove. I was concerned that the stove was too tall for the cooks, although the cooks themselves did not express this concern to me. If the stove is too tall we have a couple of stove modification options that we can explore in Phase II. If the stove is not at all satisfactory then we should redesign as per option 3 (see below)

7.2 Potential Design Modifications for the Nkokonono #20

1. Build a simple 'U' shaped brick structure at the school for the cooks to stand on.
2. Cut the stove in half so that we separate the skirt form the combustion chamber. This will require the cooks to only lift the pot to the height of the combustion chamber and then place it on the stove. Once the pot is in place, the skirt can be placed around it.
3. The final option is too build the #20 with the same general design as for the #25. I would recommend **against** this, as the existing design for the #20 is considerably cheaper than the design for the #25. If cost is not an option, however, then we should use a modified #25 design for all of the stoves.

7.3 Recommended Modifications

a. I would recommend that we should install **20% of the #20's as per the original design (i.e. with no modification).**
b. **30% should be installed with the U-shaped brick structure** to raise up the cook.
c. **60% of the #20's should be modified per option 2 (**with the detachable skirt). The danger of course is that any stove that requires modification wont be used properly and the skirt will be cast off, thus severely reducing the efficacy of the stove.

80% of the total number of stoves #25 and #20 should be built with the cement vermiculite combustion chamber. The remaining 20% should be built with the fired clay six brick VIC mixture.

8.0 WFP SFP No Food Without Fuel Project

Through meetings with WFP, 2 schools were selected for the installation of an improved stove: Sebiting Primary and St Philomena Primary. At the end of Sept we visited these schools to asses their cooking practices and fuel consumption patterns.

8.1 Sebiting Primary School

Sebiting Primary has 162 students. Of these, 97, or a little more than half, are FPE students. The FPE students have their basic school necessities (including fuel for cooking) paid for by the Government whereas the upper grades (5,6,7,) must pay for their basic school necessities. The school uses 3 cartloads per week, but FPE only pays for wood every other week because the chief provides the wood for free on every second week for the upper grades. In other words, every two weeks the school uses 6 cartloads of wood but only pays for 3 (@50ands per cart load). Taking into consideration the chiefs donation, the **total average fuelwood cost for Sebiting Primary is 75 Rand**. The 97 FPE Students receive .70Maluti per day for food. This gives a total food budget for the week of 339Rands . **This means that fuelwood expenditures for cooking account for more than 20% of the FPE**. Assuming the Nkokonono provides a modest 50% savings (which it already has already been documented at ST Philomena Primary) in fuelwood costs then the stove would pay for itself in approx 26 weeks.

Two pots are used each day. One #25 pot in the morning (for porridge) and two pots (#25 pot for pap and a #20 for pulses) for lunch. One fire is made under each pot.

8.2 St Philomena Primary

St Philomena Primary school has 278 students, 138 of whom are FPE. They use 2 cartloads (@50 Rand per cartload) of wood per week. None of the wood is donated so they must pay 100R for wood each week. Their cooking budget is 483Rand, which means that, as with Sebiting Primary, over 20% of their budget is spent on firewood
They typically use three pots per day: one cast iron # 20 for porridge at breakfast and three pots for lunch (two #25 for pap and one #20 for pulses).

What is interesting when comparing the fuel consumption figures for these two schools is that even though St Philomena has more students **they appear to use less wood**. This could be due to their cooking styles. At St Philomena for each meal one large fire is made around which all of the cooking pots are placed instead of individual fire under each pot as is practiced at Sebiting. This fuelwood conservation cooking technique could be due to the fast that St Philomena pays for all of its wood whereas Sebiting only pays for half.

Of course the difference in consumption could also be a result of some error caused by variable cartload size, under or over reporting, or some other variable that we haven't yet realized. I also just received an email from WFP saying that, according to their data, St Philomena traditionally used 50Rands worth of fuel wood each week, or half of what my survey said. We should investigate this discrepancy.

During the school visits we talked with cooks to understand the challenges that they faced while cooking. They explained that they cooked outside because they didn't have a kitchen at the present moment. They hoped that in the future they would build one. For this reason they liked the idea of a portable stove that they could one day take inside.

They also explained that cooking was difficult during winter or when it rained. During these times it was difficult to start a fire and/or cook. On occasion they actually didn't prepare food because of extremely poor weather. The Nkokonono was designed to cook even during inclement weather and initial reports suggest that it is meeting this need.

The schools typically use small diameter wood (5-10 cm) which meant that they Nkokonono's 17 cm by17cm combustion chamber didn't require them to split the wood into smaller pieces than they were already using.

10 schools need to be selected for the initial dissemination Of 20 stoves. The first step should be to **assess the types of pots that are being used by each of the 10 schools**. We would assume that each school has one #25 potje and one #20 potje and so we need one #25 and one #20 Nkokonono stove per school. This might not be the case. For example St Philomena Primary school, where we placed two stoves during phase 1, had three pots – two #25 potjes and one #20 pot. The cooks explained that they divided the food into three pots because it cooked faster than with two. This makes sense as 3 pots have more cooking surface exposed to the fire. However, with the new stove they would probably only need to use two pots. In that case we should provide them with **two** #25 stoves. This information should be captured in the initial assessment performed by Andres Michel: how many pots are used and why, and, if they were given two stoves, would it be sufficient to meet their cooking needs. We want to avoid, if possible, a situation where they are using our stoves but continue to build an open fire to meet their cooking needs.

8.3 The way forward with dissemination

How to distribute the stove via WFP?

Option 1

- **Full subsidy from WFP.**

The stoves would be purchased through a partnership with an international partner i.e. Government of Japan.

This approach has typical drawbacks that are associated with donor gifts (e.g. gifts develop a dependency and are often devalued by the user). While I think this is true in terms of the household stove market I think there are important differences in the school/institutional market. For example, the cooking pots are presently donated by WFP and I am not aware of a problem with the pots being underutilized because they were received as a gift. And, unlike the subsidization of food through the WFP, there is no danger of undermining or destabilizing the local stove market; on the contrary, it will augment it. The purchase of 1000 stoves will create seed money to create a commercial non-subsidized stove business that can sell household/institutional stoves and ovens.

Option 2

- **The ministry of education pays for all or part of the stoves**
- Because the Ministry of Education supports the FPE it would seem sensical that they would be eager to support the stove program. However, at this point, they support school feeding with a .70 Maluti per day subsidy. If they were to purchase the stoves they would have to reduce the .70 Maluti that is presently paid to the school's cooks. This, and the lack of interest so far demonstrated by the Ministry of Education, suggest that this approach will not be fruitful

Option 3

- **The school cooks purchase the stoves outright or through a microcredit/layby plan** These women have a strong economic incentive to reduce wood consumption as wood purchases come directly out of their cooking budget. They are presently given a fixed payment of .70Maluti for FPE student in the highlands. Of the two schools that we worked with approximately 20% of their cooking budget was used for firewood. So fire wood savings could pay for the stove in approx 20-26 weeks

The .70 Maluti FPE subsidy is increased to 2 Maluti in the lowlands. **It should be noted that many cooks use Kerosene, LPG and/or electricity in the Lowlands, so marketing the stove in these regions might be counterproductive to our stated goal of BEC.** As it stands in the WFP/ProBEC action plan, 5 schools are going to be chosen form the Lowland area. I would recommend against this. **All of the 10 stoves should be placed in the highlands**. If ProBEC feels that stoves must be placed in the lowlands then we must be sure that the chosen schools are entirely reliant on biomass for the cooking .

The Nkokonono stoves still need to be tested for overall efficiency. These tests will be done by the consultant upon his return to Lesotho using the new Aprovecho/Berkeley / Shell Foundation Method for assessing stove performance and efficiency.