

Shea Nut Processing

Silver B



Mock-Up Review
October 18, 2007

Customer Contract

Product Description:

A bicycle-powered shea nut mill

Customer:

Small-scale shea nut producing villages in sub-Saharan Africa

Market:

Fair-trade agricultural products

Cost:

Customer can afford \$150
for a multiple-family unit



Product Contract

Customer Needs	Product Attribute	Engineering Specification
Helps with shea butter production process	<ul style="list-style-type: none"> ▪ Turn shelled shea nut into paste 	<ul style="list-style-type: none"> ▪ Grain size < 1mm
Improvement on traditional methods	<ul style="list-style-type: none"> ▪ Faster than mortar & pestle ▪ Require low power & pestle 	<ul style="list-style-type: none"> ▪ Output > 1.2kg/hr ▪ Input Power < 60W ▪ Output > 1.2kg/hr
Manufacturable & repairable locally	<ul style="list-style-type: none"> ▪ Made from locally available materials ▪ Made from locally available materials 	<ul style="list-style-type: none"> ▪ Steel fastened with welds ▪ Steel fastened with welds ▪ Reproducible by local welders
Comfortable to use	<ul style="list-style-type: none"> ▪ Ergonomic design 	<ul style="list-style-type: none"> ▪ Use 2 hours w/o pain or discomfort

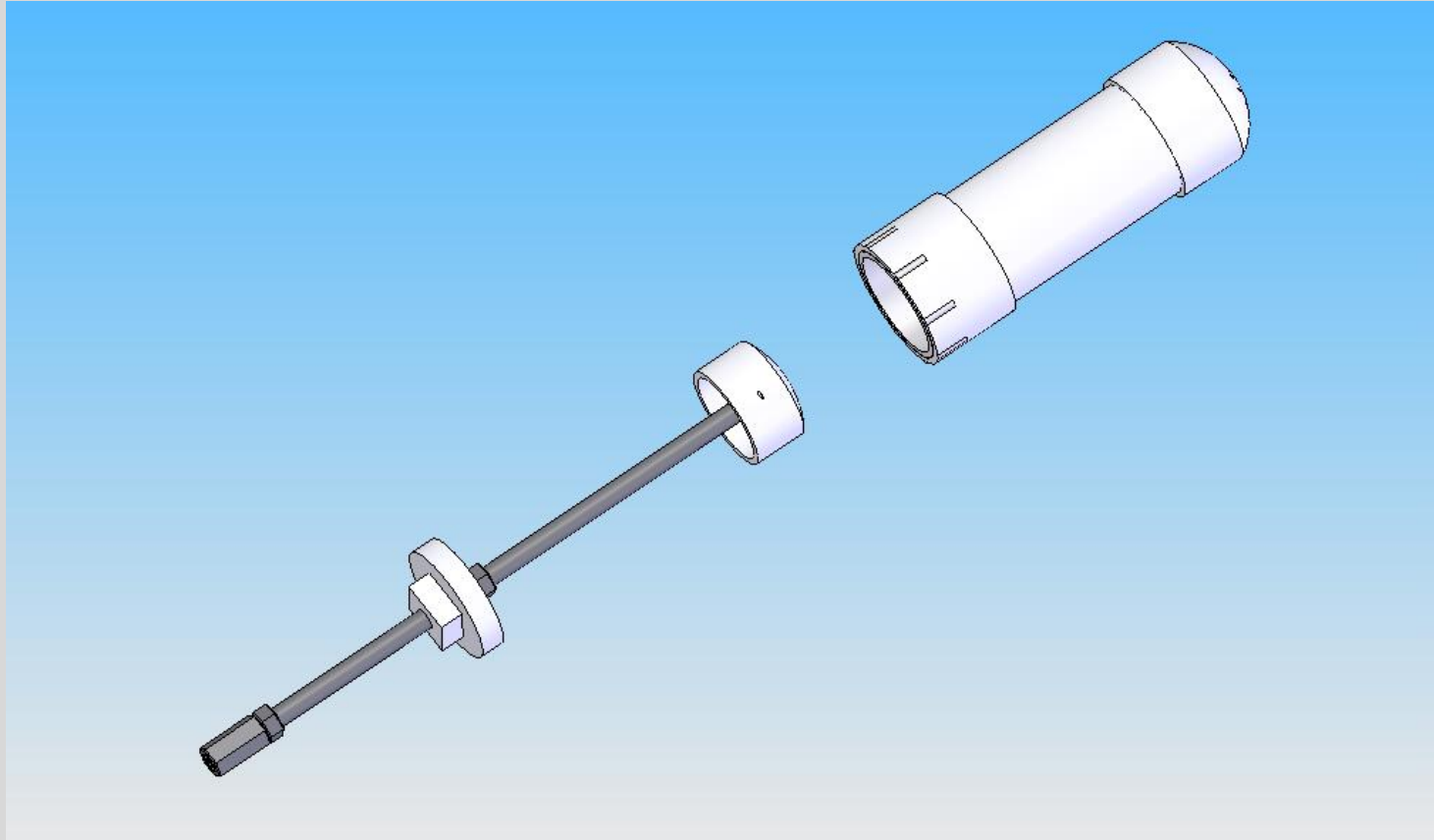
Risks and Issues

- What are the iPower Requirements
- How Easy is it to Use?

What is the Best Way to Grind?

- Auger-fed mill

Press (compression only)



Gravity-Fed Mill



“I knew MIT kids could not have designed this to be the real thing.” -Anonymous User

Press & Grind



“The nuts developed a smooth finish.” -Brad

Auger Fed Mill



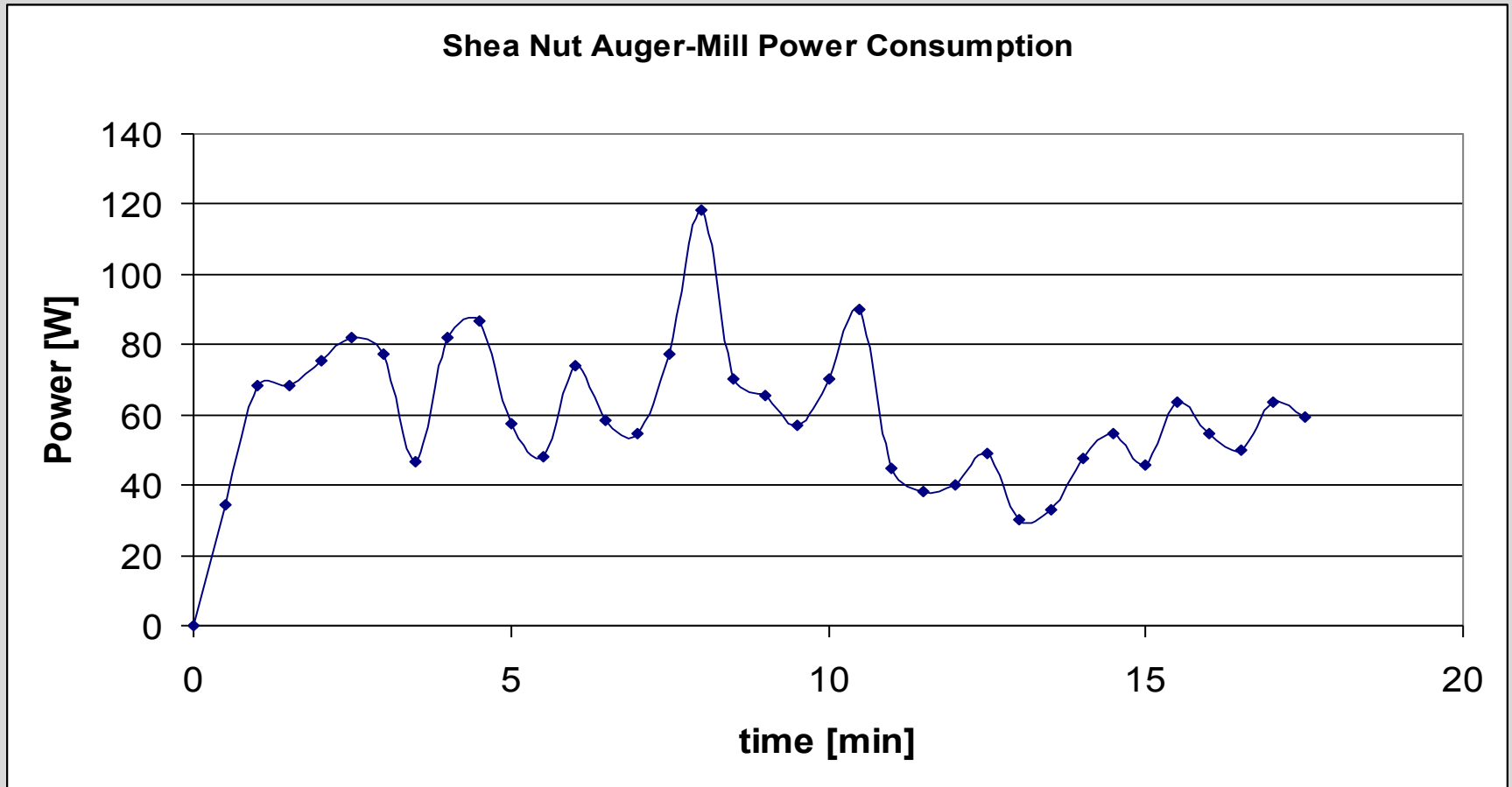
“Hey, shea butter.” -Karen

Grinding Method Comparison

Grinding Mechanism	Press	Gravity-Fed	Press & Grind	Auger-Fed
Reliability	0	0	+	+
Paste Quality	0	0	-	+
Constant Feed?	0	+	0	+
Output Rate	0	0	0	+

Using our sketch model (the press) as a baseline

How much Power is Required?



$$\text{Power} = \text{Torque} * \text{Angular Velocity}$$

Is it Easy to Use?



Enticing Sign

Nut Grinder

“Do not eat...” Sign

Empty Bowl

Bowl of Peanuts

Conclusions

- Best way to grind? Auger & Mill plates
- Human Powerable? Yes
- Intuitive to use? Yes

Initiation

Harvest
fallen nuts

Remove Fruit by
Burial **12 days**

Removing moisture for easier shelling

Parboil

Roast or Sun Dry
3-4 days

Making paste for easier oil extraction

Roast, Stir constantly with
heavy stick **3-4 hours**

Pound w/ Mortar
& Pestle **30 min**

Ground to Paste (**3-5 women w/ giant
mortar & pestle, or several women
with grinding stones**)

Roast

Shell & Winnow

Shelling & more
moisture removal

Add Water and
Knead by Hand
30-90 min

Remove Fat
from Emulsion
Using Large
Spoon

Wash Fat
Repeatedly

Boil Fat
Repeatedly

Decant
Repeatedly

Stir
Constantly

Stir & Cool
Decanted
Butter

Extracting the oil – best non-chemical results by hand

