The Finned Pot as a Means of Increasing Efficiency- Recent Research

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April 2007 through January 2009

- About 200 tests done.
- Overview of this work will be presented here.
- Publication with more details done by late February.

Heat transfer to pot =

Heat transfer coefficient * Area * (Tgas - Tpot)

Solution

- Increase the pot surface area A LOT!!
- Add heat transfer fins. Increase area 3 to 10 times.
- The key to an efficient stove is the pot!!

This is good news, because:

- You can redesign the pot without fouling up the operation of the stove.
- A good pot works well in all conditions.
- Generally you can do more good with less money.
- Fins can be retro-fit to existing pots.

What can be done with fins?

- Five types of fins by Andreatta
- Tested under a variety of conditions.
- Other fins by others.

Simulated rocket stove

Simulated open fire

Simulated rocket stove with base

Chinese rocket stove using gas

Test procedure

- Simulate wood flame with natural gas.
- Measure and control natural gas flow rate.
- Test unfinned pot first. Measure heat transfer rate in Watts.
- Add fins to same or very similar pot.
- Test finned pot under identical conditions.
- Calculate factor of improvement.

Bottom fins

- Probably the most practical method.
- Pot looks “normal”.
- Issues with keeping pot shiny and clean.


KITCHEN

Results for bottom fins

- In the lab, increase in heat transfer is about 1.76.
- In actual use, fuel savings is about 30% in water boiling test with wood and Chinese rocket.
- Performed poorly with kerosene and alcohol.

Chinese prototype with bottom fins

Chinese prototype with bottom fins and attached skirt

Chinese finned wok

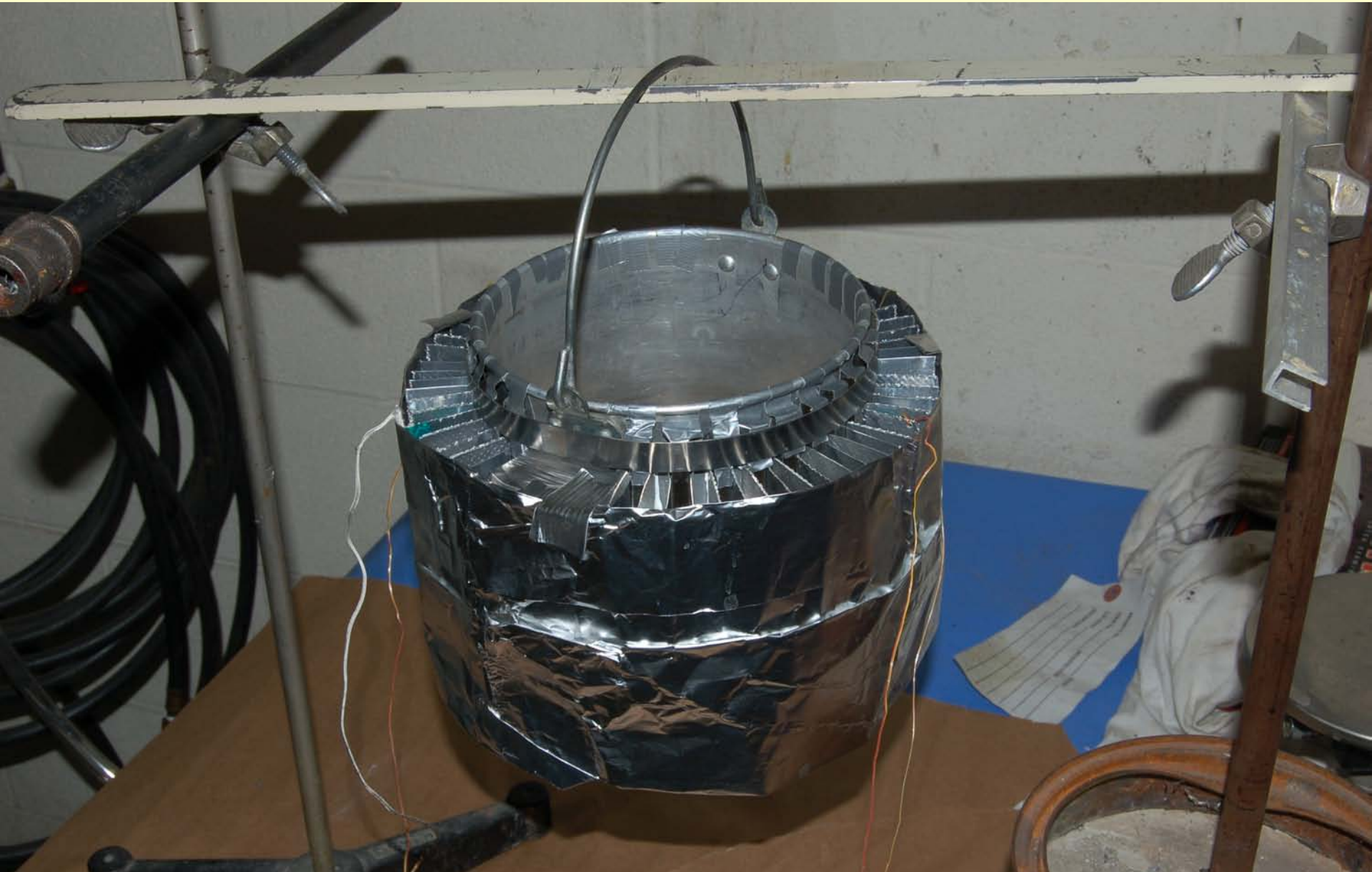
In mass production

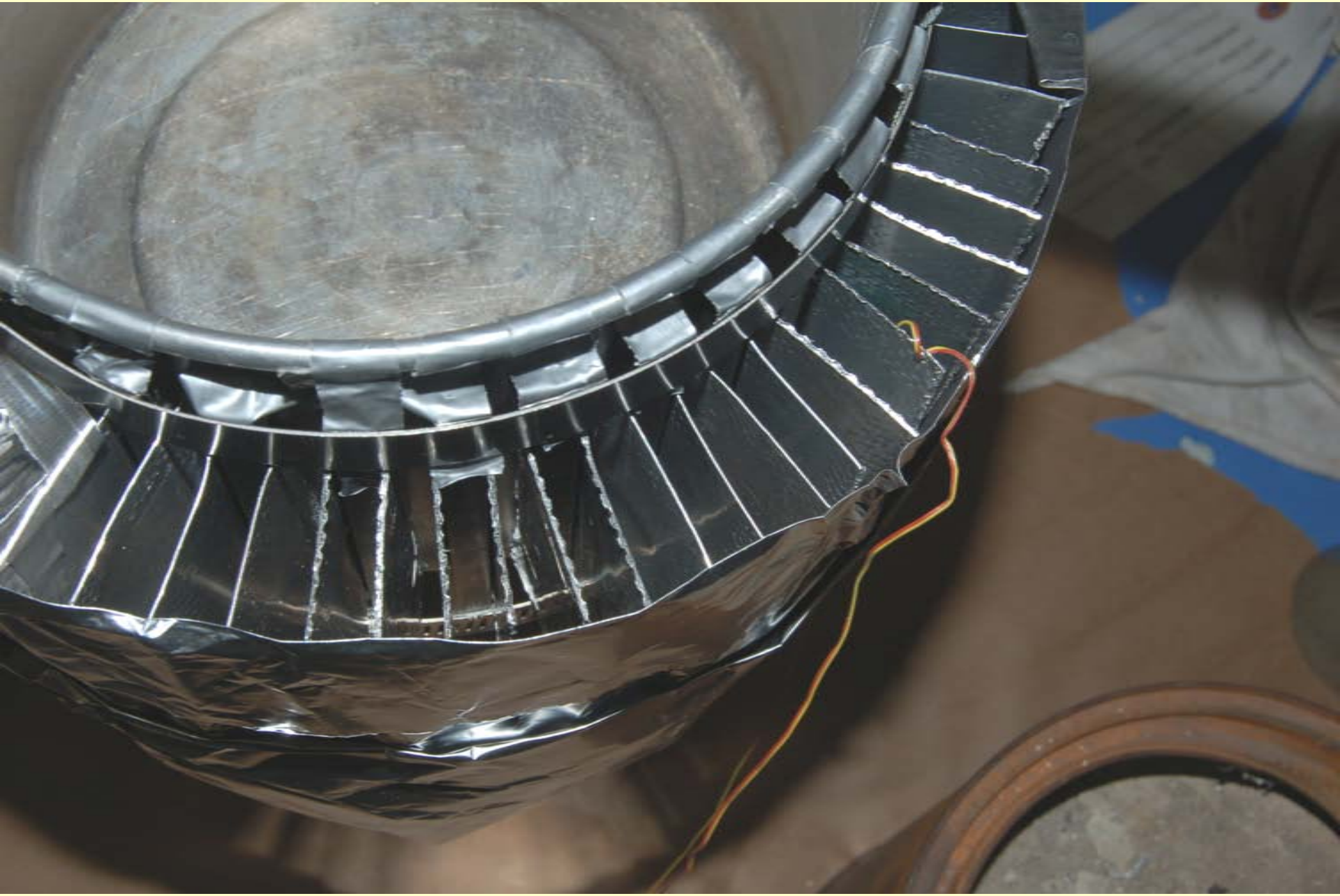
- Fins would be mass produced.
- Fins would be furnace brazed to pot.
- Possibly spot welded.
- Possibly cast as with the Chinese wok.

Side fins (radial type)

- Probably the best way to increase heat transfer.
- May look “weird”.
- Fins may get dirty, but outside of skirt stays clean.

Radial side fins

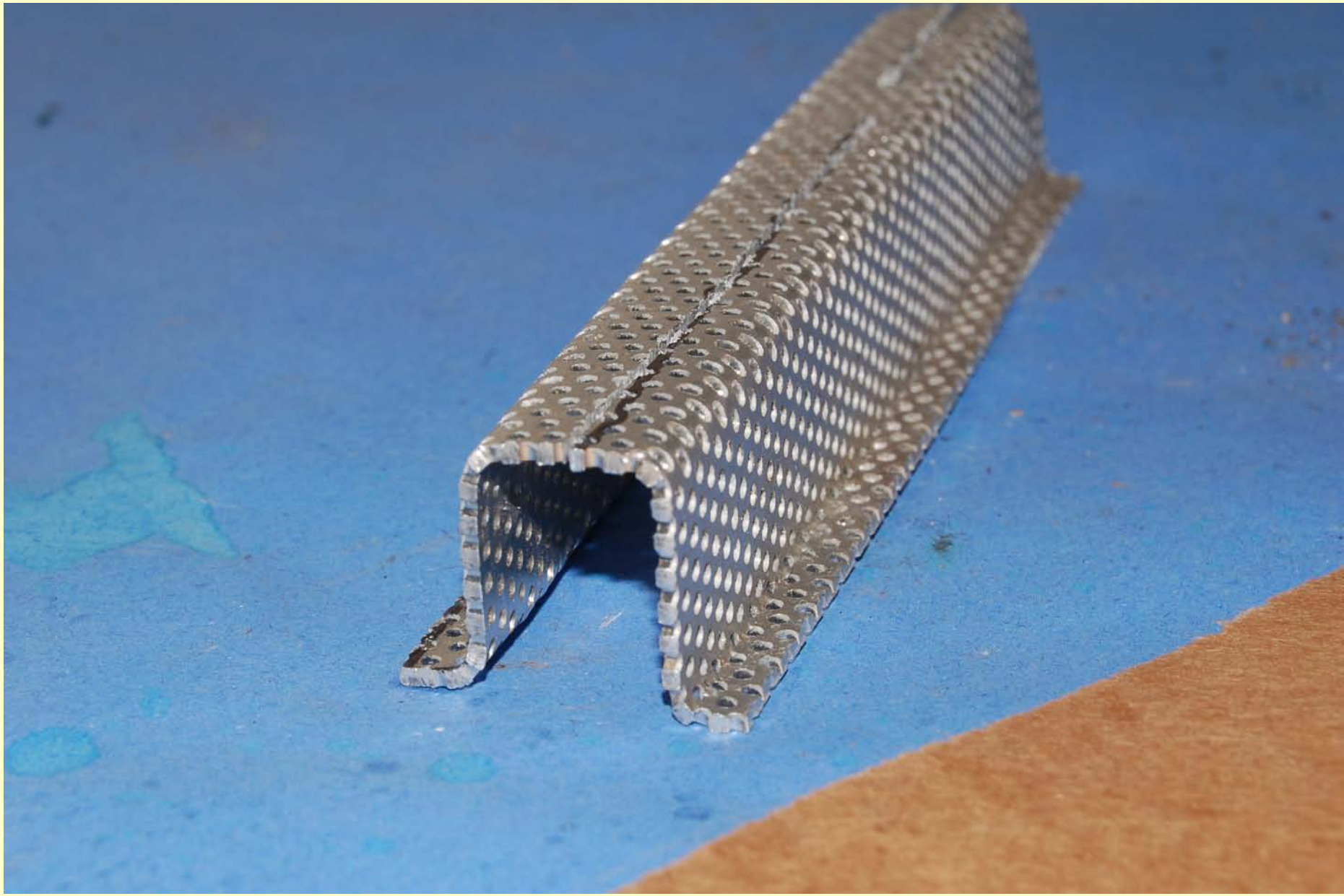




Results

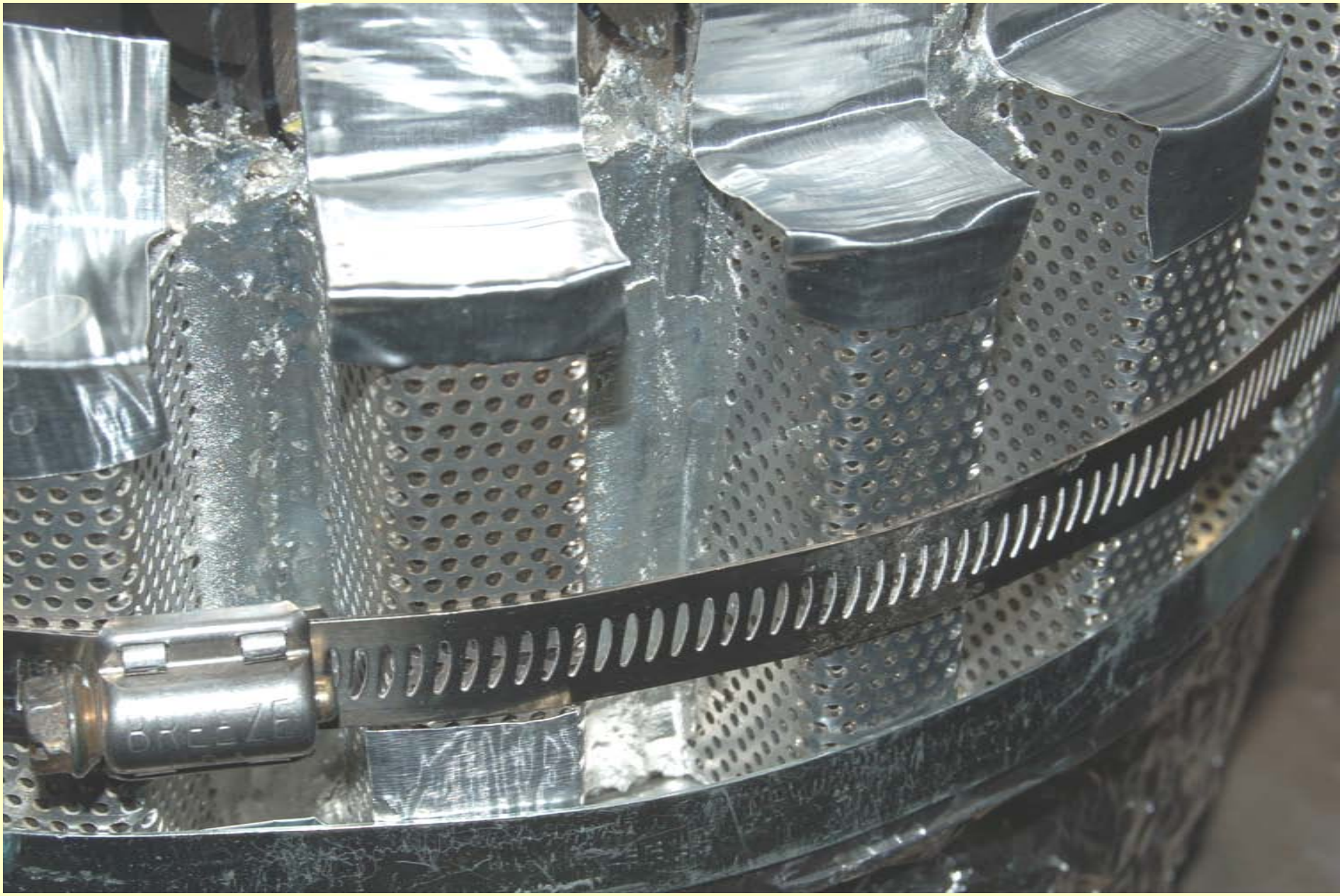
- Heat transfer improvement is about 2.4 with this small pot, but not as good with larger pot.
- Having a skirt around the fins is important.

Side fins-perforated metal type



Perforated metal fins on the sides

- Hot gas flows through small holes in the fins.
- Holes must be small (1/16 inch or 1.6 mm).
- Can achieve heat transfer coefficients several times higher than when hot gas flows around the fins.
- Holes may clog with ash.


BREEZE

Results

- Best channel arrangement gave improvement in heat transfer of about 2.2 in the lab.
- Fins could be improved further to give perhaps 2.4 improvement.
- Actual wood used on Chinese rocket stove was 54% of what standard pot used (46% savings).
- Time to boil was 59% of standard pot.
- Performed poorly on kerosene stove.

Corner fins only 1.56 improvement

Slit fins can be retrofit to an existing pot

- The slit fin design is a ring of aluminum that clamps around the sides of the pot near the base.
- Slits are cut into the ring, and the “fingers” extend into the hot gas zone, picking up heat.

Results for slit fins

- About 1.76 factor of improvement in the lab.
- Typically about 30% savings in actual wood fuel use on Chinese rocket stove.
- Saved 48% of the fuel on an open fire test.
- Performed poorly on kerosene and alcohol stoves.

Summary

- Fins can give large increases in heat transfer.
- Many types of fins available, bottom, side, bottom corner.
- Retrofit fins are also available.
- Generally perform best on open fire.
- Seem to perform poorly with industrial fuels.