

Ceramics in Environmental Health

- Genuinely sustainable technologies for all -



- Water filter media and systems of silver coated, granulated ceramics
- Insulating ceramic rocket stoves



Reid Harvey – rharvey@tamceramics.com

University of Michigan, Sustainability and Development Conference

October 11, 2019

Ceramics in Environmental Health

A. Reid Harvey - PowerPoint presentation - Session 69, Sunday 1:00pm

Slide 1: I'm happy to be here. The focus is environmental health, genuinely sustainable technologies for safe drinking water and clean cook stoves.

TAM Ceramics aims to maximize the numbers of those who get safe drinking water by 2030, using large scale water filters of granulated ceramics. Here at the conference the aim is to share totally sustainable household-scale technologies of safe water and clean cook stoves that can be produced by local people nearly anywhere using local resources.

So you know, in much of the developing world there are local ceramists who produce products like water storage containers, cook pots and construction bricks. They tend to be capable of a whole lot more.

Morbidity due to drinking water and cookstoves

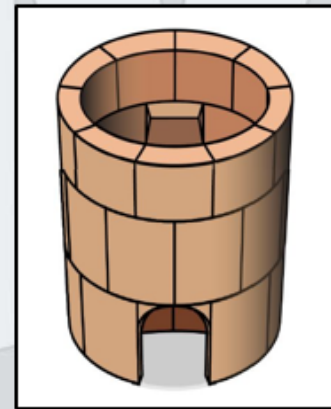


- 'Globally, at least 2 billion people use a drinking water source contaminated with faeces.'

<https://www.who.int/news-room/fact-sheets/detail/drinking-water>

- 'Exposure to smoke from cooking fires causes 3.8 million premature deaths each year...'
i.e., 10,000 deaths every day.

<https://www.who.int/airpollution/household/health-impacts/en/>



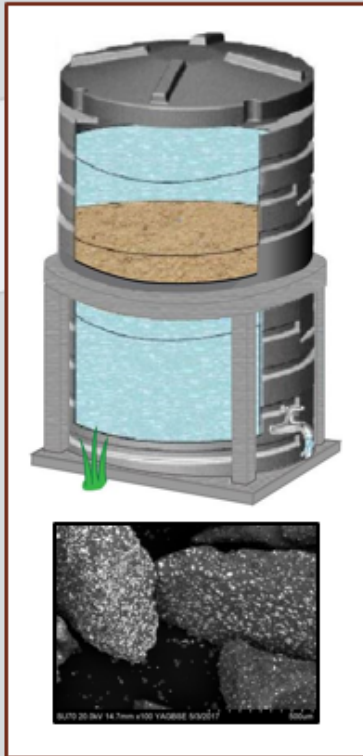
☞ — Denotes lazer pointer images

Slide 2: People know about the problems with drinking water in the developing world, that small children die from dysentery due to diarrhea. But far greater numbers die due to smoke and fumes around cook stoves.

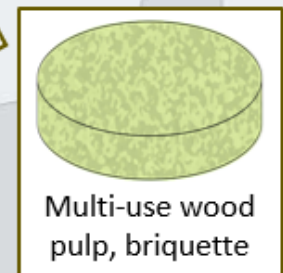
☞ Here's the box label of a candle filter system from a 2003 project in Nepal. The first granulated filters were made by crushing and granulating candle filters, then sizing the granules for an appropriate rate of flow.

☞ For this insulating ceramic rocket stove there are nine bricks going around, pot rests at every third brick. The fire is enclosed so bio-mass solid fuel burns very hot. Unlike other stoves there's no smoke since it burns up.

Large scale water filters of silver treated granulated ceramics



- Large-scale, POU safe water
- Very low cost and user-friendly
- Maintained by humans. Just gravity. No chemicals, electricity or gadgets.
- *Natural flocculants* sediment particles. E.g., farm-produced agri-waste for subsequent briquettes
- Ten-year lifetime



Slide 3: For community filter systems genuine sustainability means that these will be low cost and user-friendly, with easy maintenance. This system is large and should get safe drinking water to about 2,000 people. Here are three granules, each around 1/50th of an inch across. The white specks are silver, bonded to the granules.

This is a multi-use wood pulp briquette, the material first to be used as a natural flocculant to sediment the particles of turbidity prior to putting the water into the filter system. But a bit more research is needed.

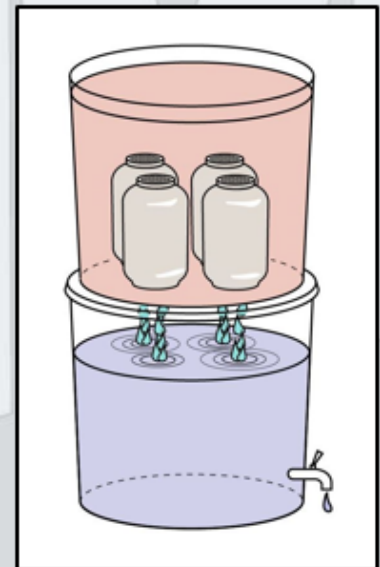
TAM is advocating a human centered approach to water treatment, since for the poor the municipal approach, with its chemicals, gadgetry and electricity, is not sustainable. A big part of changing over to human engagement will be the sedimentation of the particles in turbid water.

About the stoves, for the second use of the wood pulp, after sedimentation of particles this will be placed in other water to break down, then pressed into briquetted fuel for the stoves. Please understand, the use of carbonized fuel will be found not to be good practice when considering that bio-mass briquettes burned in a rocket stove will give no smoke.

Water filters for households

- Household systems in PVC pipe
- Flow at 2.0 liters per hour
- Only boiling has achieved scale

Elsevier, Journal of Hygiene and Environmental Health,
218 (2015) 704 - 713



Filters for schools or clinics

- Filter media in 4.0-liter plastic jars
- Flow at 380.0 liters per hour

Slide 4: These are the very first household filters of the granulated media, from 2003 in Nepal. And here's a filter system for schools or clinics. Both types of system should be put together from locally available containers and parts, TAM's filter media received in bulk. Here as well is a drawing of a Moringa tree, the seeds of which can be used to settle out the particles, for water poured into the household filter system.

Insulating ceramic rocket stoves



- Very low cost. Reproducible nearly anywhere using local resources.
- Bio-mass fuel, e.g., agri-waste briquette with *no smoke*. *No carbonized fuel!*
- *Charcoal deforestation! Production requires 5 times it's weight in wood!*

- Curved bricks are insulating, *50/50 powders of clay and charcoal* and remarkably light weight.
- Bricks laid up using mortar mix of *50/50 powders of clay and sand*.



Slide 5: This is the first insulating ceramic rocket stove, several of us put together in 2007, in Eastleigh, Nairobi. Patrick who's looking on is amazed that there's no smoke. We used sheet metal wrapped around, but chicken wire will work just as well. Or don't even bother with the chicken wire.

↳ These are newly formed curved bricks for the stove, 50 - 50 by volume, powders of clay and charcoal. The charcoal burns out giving the characteristic brick color. But for use as fuel charcoal is terrible, especially in arid regions, due to its impact on the environment. Its production requires five or six times it's weight in wood and vast areas of land have been deforested as a result.

Human engagement is essential

Granulated ceramic water filters

- Managed thru community committees. M&E over time.
- Sediment particles. Top off contaminated water.
- Behavior change must involve hygienic practices.

Insulating rocket stoves

- The poor might pay with labor.
- Stoves introduced by neighbors who build them, giving support over time. *No 3-rock cooking!*
- Stoves pay for themselves in savings on charcoal.

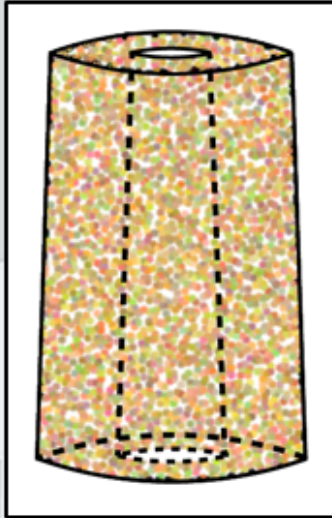


Yahoo Video

Slide 6: Water filters and cook stoves done in the same project will be in synergy, in production and in use, in resources and capacity, and in the user group and the environmental health. This will make human engagement simpler, community committees deciding on management and logistics.

For both filter systems and cook stoves, users will need to be familiarized. In water collection users need to be aware of the hygiene of hand washing and cleaning of water containers. New users of the stoves may need follow up visits, not to get discouraged and go back to cooking on three rocks.

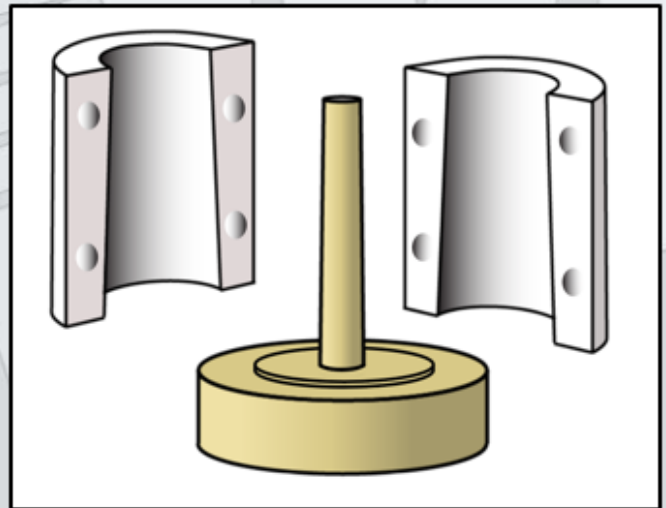




A household water filter, monolithic candle

- Powdered charcoal burns out for voids, facilitating water flow.
- End caps sealed on with silicone are plastic or ceramic.

- Gypsum plaster mold with wooden base & spindle
- Center spindle to pull out
- Filter removed after a few hours, dried and fired.



Slide 7: This candle filter resembles the Nepali one. I haven't put any of these together, since the granulated filters systems have so many advantages, but this will definitely work and should satisfy with flying colors the requirements of the World Health Organization – W.H.O.

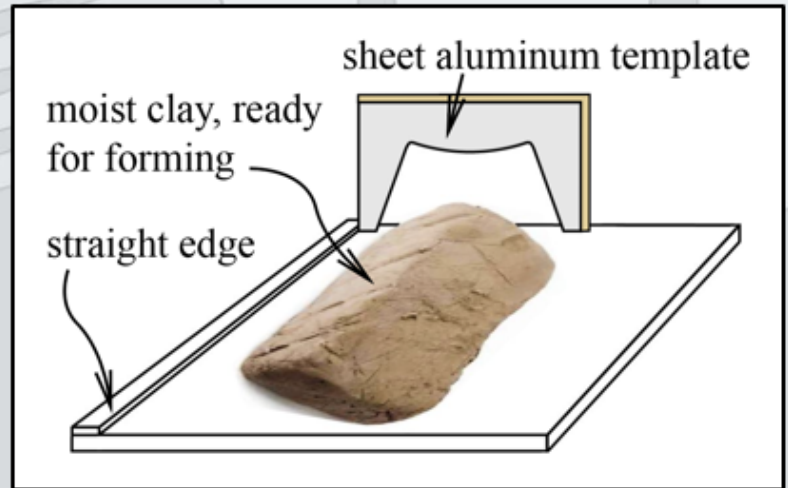
↳ This is a gypsum plaster mold, plaster useful in forming ceramic products of many kinds. I can get instructional material to anyone interested in learning about model and mold making.

Forming the curved bricks of stoves



- ‘*Master molds*’ of epoxy resin allow casting of gypsum plaster ‘*working molds*.’
- Four master molds allow for all diameters of cook pots.

- As an alternative an aluminum template is pulled over moist clay in an additive and subtractive process.



Slide 8: Here are four master molds of epoxy resin, for making the working molds of plaster for forming the curved bricks. Using these master molds, stoves can be built for pots of any diameter between 24 and 48 cms.


→ This master mold, turned up-side-down resembles one of the curved bricks, and gypsum plaster is poured over it for a working mold. But these master molds are not necessary if one uses a template like this one. I can also get people the JPEG images needed for the aluminum templates. →

For this the clay form should approximate the shape of the brick. Then the aluminum template is repeatedly pulled over it, alternatively taking off the excess clay and filling in where it's needed. Once the brick is properly formed, gypsum plaster is poured over it to produce a working mold.

Tanzania stove takeoff



Thanks to the Kibondo, TZ, stove team: Christopher, Happiness & Samuel, in hand-forming bricks of over 50 stoves, and to the project Director, Fr. Bartholomew Segu. Plans are to build awareness through song and dance.

Slide 9: In Kibondo, far west in Tanzania, the insulating ceramic rocket stove has come to light and these are two members of the stove team,  Christopher and Happiness. The stove production is so simple that one of them for a very large cook pot had already been put together by the time I got there in 2016. Planning was through a lot of email with the director, Fr. Bartholomew Segu, who has worked tirelessly to make this happen.

A catenary arch kiln of local materials




- Fabricated from local clays nearly anywhere with no metal components
- For water filters, maybe stove brick
- Firing all types of ceramic ware
- Charcoal foundry aluminum casting

<https://www.youtube.com/watch?v=IX6yFQnNk-A>


- High fire kilns allow for salt glazed, floor level 'squat' toilets.
- Septic tanks built with brick.
- Ceramic science is the study of inorganic, non-metallic substances at high temperature.



Justin Lambert Pottery

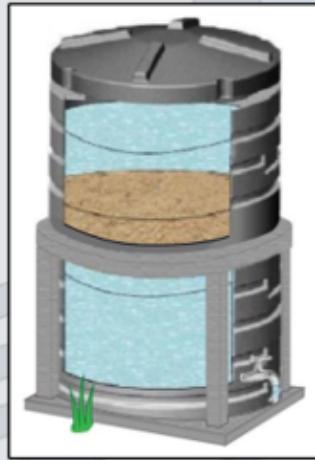
Slide 10:  This catenary arch kiln is self-supporting, viable nearly anywhere using local clays. With the right clay and bricks, production of sanitaryware, salt glazed squat toilets will be possible. Then public toilets can be built over septic tanks built out of the local construction brick.

In firing the toilets, at the high temperature common salt... sodium chloride... should be thrown into the kiln. The chloride burns off and the sodium combines with the silica in the ceramic; ceramic being alumina silicate. The glassy glazed surface will allow easy cleaning.

 Here's a link to a simple charcoal foundry, allowing casting and working of aluminum. Another link at the site leads to a series of small books, *Build Your Own Metal Working Shop From Scrap*. The parts for the machines of the workshop can be cast using the charcoal foundry along with ceramic molds for multiple parts. The books describe green sand molds, but these are not so robust. The ceramics along with metal skills could help in fostering innumerable livelihoods of products as well as services.

Partner with TAM Ceramics!

Environmental health for the poor and for all
will jump start accomplishment of the 2030 goals



Contact Reid Harvey: RHarvey@TAMCeramics.com

Visit TAM Ceramics: 4511 Hyde Park Blvd.

Niagara Falls, NY 14305 USA



Slide 11: TAM Ceramics aims primarily to maximize the numbers of those vulnerable who get safe drinking water by 2030. In the meantime, the household filter shown in slide 7 should meet current W.H.O. standards with flying colors. Producing the filters as well as the stoves is possible almost anywhere, with the help of local ceramists and simple training.

The products and processes of ceramics in environmental health could well give rise to a holistic approach to development, maximizing achievement of nearly all of the 2030 goals.

TAM Ceramics

WATER FILTER MEDIA OF GRANULATED CERAMICS

4511 Hyde Park Blvd., Niagara Falls, NY 14305 USA

Email: RHarvey@TAMCeramics.com

Telephone: 1-716-278-9550