Rocket stove

Description

For burning biomass on household level, the rocket stove design currently gives you the highest efficiency and burns the cleanest.

The basic design is fairly simple. There are, however, some essential issues to take into consideration. These specifics, as listed below, will make sure that within seconds to a few minutes following ignition, depending on the size of the oven and material of the riser, a continuous hot flame will be created that sounds like a mini-rocket. The temperature in the riser reaches well over 1000 C, which is why it burns so clean. Heat is extracted mainly from the exhaust, for example, on top of the riser. This is the most common application, hence the name "rocket *stove*". The second popular application is the "mass heater". Because of the enormous draft of the rocket stove, the exhaust pipe can be laid out horizontally along a length of several meters, so it can exchange heat inside a bench (for example), made from a box with pebbles, or made of clay.

There are basically two types of rocket stoves: J-models with vertical wood input, and L-models, with horizontal input. J-models are usually small because they require thin pieces of wood that are either time consuming to make or expensive to get. Because they glide down as they are burning up, they give a rather continuous fire in between feedings with wood. The L-model can be equipped with a larger burning room in

Fig 3.41, fire of the pizza oven
Photo by Julie Ann Riemersma

order to batch feed it. The advantage of the L-model is that it can be fed practically anything of any size, whatever fits. However, the fire is less constant, and therefore when not carefully monitored, it can be efficient in the end less and thus more polluting.

Specifics needed for the rocket to take off:

- Heavy insulation of the riser in the stove
- The riser should be made of light fireproof materials for a good refraction, quicker heating and therefore better overall performance.

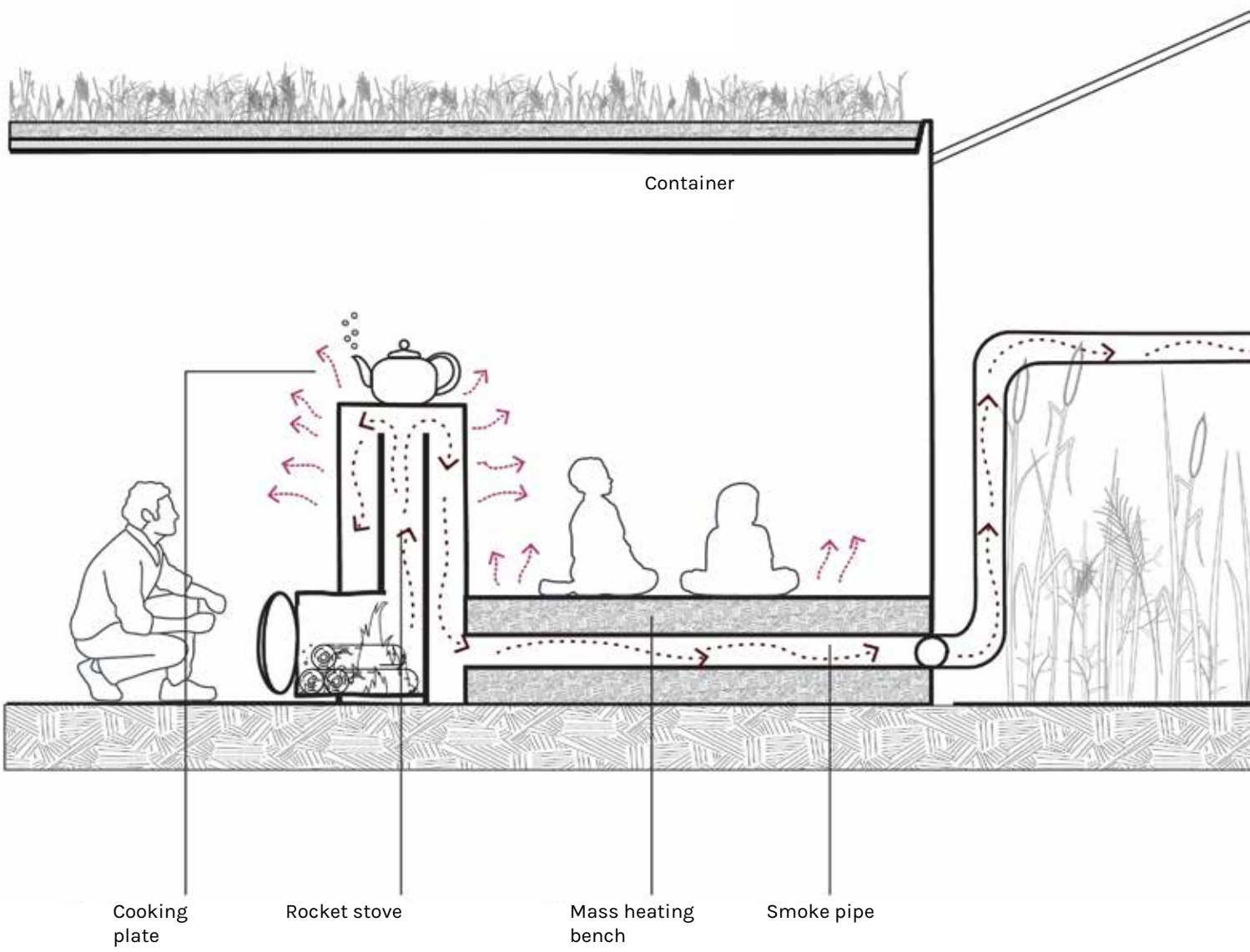
Specific for the J - model:

- Length of burning tunnel max 1/2 of the riser
- Height of wood intake max 1/3 of riser

Specific for Batch burners, L - models:

- A secondary air inlet towards the beginning of the riser. This should be 5% of the cross sectional area of the riser.
- Adjustable main air intake

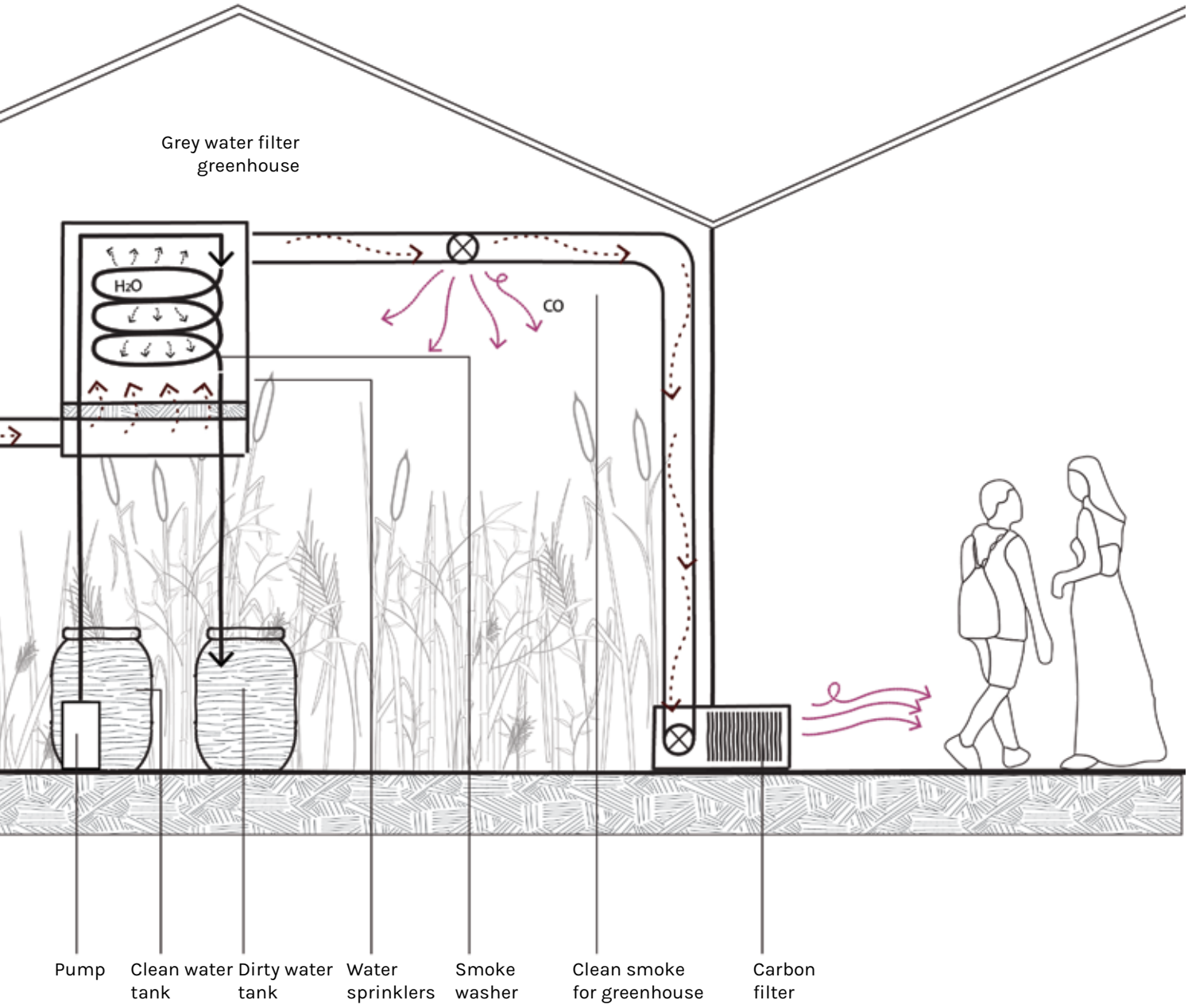
Fig 3.42, rocket stove integrated system,
Illustration by Alessandro Rosa



9. https://en.wikipedia.org/wiki/Ianto_Evans
10. http://aprovecho.org

Forum:
https://donkey32.proboards.com/
https://www.rocketstoves.com/
http://batchrocket.eu/en/
https://walkerstoves.com/index.html
https://lifeboat.com/InfoPreserver/images/e/e2/39346203-How-to-Build-A-Rocket-Stove-DIY-AT-HOME_%281%29.pdf

The rocket stove was first invented by Ianto Evans[9]. He worked with Larry Winiarski, who tried to take most of the credit for it. They agreed to separate, and so the J-model was henceforth attributed to Ianto, and the L-model stayed with Winiarski with the non-pofit organisation Aprovecho[10]. Since then, there have been many people working to improve the designs of both types. The batch-burner design came as a third type as a solution to reduce the rather time consuming activity of wood filling associated with L and J tubes.



Materials and construction

The design that we present here are two batch-burners that are used to heat a pizza-oven. They both have a riser diameter, equivalent to a 15 cm diameter pipe, and an exhaust pipe from the oven with a diameter of 20 cm. The rocket stoves and pizza-oven are made of new and recycled fire bricks, with an insulation of rockwool and a cover of 20 to 30 cm of a local clay-sand mixture.

Materials

- 272 new fire bricks for the original burn chambers and the vault of the pizza oven, about 10 large fire bricks for the pizza oven recycled from an old chalk burning factory, and around 54 of thin fire bricks for the riser.

- Recycled rockwool to insulate the burning chamber, riser and pizza oven.

- One M3 of dirt with some good clay content

- The first meters of the exhaust pipe must be made of thick steel, however, in case of a heat bench (exchanger) is built in, the heat of the exhaust fumes are so reduced that cheaper materials are possible. Also the smoke channel in the heat bench can be made of (smooth) brick walls

- 1 meters of 20cm diameter steel exhaustpipe

- 5 meters of 20 cm diameter recycled ventilation pipe

- 1 meter of 25 cm diameter recycled ventilation pipe for go through side wall or roof

- Steel plate for welding the doors together of the two batch burners

Construction

The construction is quite simple, basically laying down bricks like lego, and covering it with rockwool and cob. There are several tricky things that require more careful attention.

1. The secondary air inlet is welded from iron tubes, in the shape of a "bird mouth". This requires obviously some welding skill. It would be possible to have the air inlet cut into the back of the bricks, also some skill would be needed here also.
2. The back of the burning chamber should be made quite solid to prevent that aggressive wood loading will kick out fire bricks from their positions. To prevent that, the riser can be constructed at the side of the burning chamber
3. The size of the slot between the burning chamber and the riser should

Fig 3.43, Front view of the Pizza oven with a system of two batch-burners below,
Fig 3.44, Pizza oven in action
Photos by KasKantine

be 65-72% of the chimney/riser diameter also known as the cross sectional area.
4. Cob making is a separate profession, but shortly: if local clay is used, or simply dirt, first the relation needs to be found in which extra sand needs to be mixed in order to prevent cracking. This can range between 3:1 sand/dirt and 6:1 sand/dirt, the latter representing almost pure clay. Recommended is to make 5 to 10 samples, and apply a layer of one cm or so on some wet brick (soaked for one night) to identify the optimum between stickiness and absence of cracking. A quick and dirty method is to make a ball of your test mix and if it holds its shape but will crack when squished you know it is about correct.
5. The oven needs clean-out access points on places that you cannot reach once the oven has been built. For example at the back of the burning chamber and within the exhaust pipes.
6. Horizontal pipes must be laid out with a small inclination towards a lowest point with a small exit for condensation water.

Fig 3.45, pizza oven section, Illustration by Alessandro Rosa
Fig 3.46, Pizzas cooking in the oven
Photos by KasKantine

Maintenance

- After several uses, the ash needs to be removed from the burning chamber.
- Small crackings of the cob can be washed away with a wet towel.