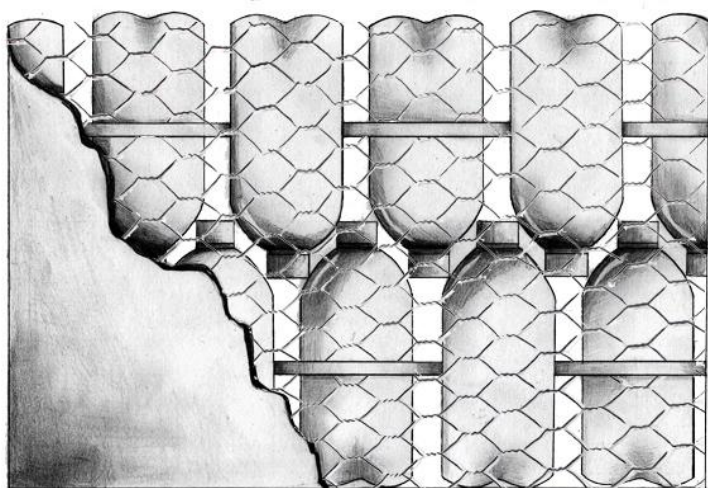


Making Waste Work: A Toolkit

How to turn mixed plastic waste and bottles into ecobricks

A step-by-step guide



How-to guide 9

Part of
Making Waste Work: A Toolkit
for community waste
management in low and middle
income countries

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wasteaid.org.uk/toolkit





WasteAid UK is a charity working to make an impact on the global waste emergency by:

- Partnering with local organisations to improve the health, environment and livelihoods of people without waste services.
- Building the skills of local people to deliver practical solutions to the waste management crisis in their own communities.
- Raising awareness of the benefits of proper waste management and campaigning for greater change.

www.wasteaid.org.uk



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The objectives of the CIWM are to advance the scientific, technical and practical aspects of wastes and resource management worldwide for the safeguarding of the natural environment, to promote education, training, and research in wastes and resource management, and the dissemination of knowledge of the topic; and to strive to achieve and maintain the highest standards of best practice, technical competence and conduct by all its members.

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9 How to turn mixed plastic waste and bottles into ecobricks

Instead of cutting down trees or using concrete blocks, re-use plastic bottles to form the structure of your home. To make an ecobrick, stuff washed flexible plastics and polystyrene into a plastic bottle and replace the lid.



Summary: Wash and dry flexible plastic waste and polystyrene, and stuff it tightly into a plastic bottle to make an ecobrick.

Waste materials: Any type of flexible plastic waste such as snack wrappers and plastic bags (washed and dried in the sun), Styrofoam (polystyrene), plastic bottles.

Product: Ecobricks.

Benefits: Some plastic wastes cannot be recycled easily, but they cause a lot of problems if they are dumped or burned. Ecobricks contain the plastic waste so they do not cause harm in the environment, and provide a free construction material that is highly insulating, lightweight and robust.

Everyone in the community can join in, including children. Thousands of homes and schools all around the world have been built using ecobricks.

Hint: Ecobricks can also be made from filling plastic bottles with earth.

Figure 1: Make an ecobrick by stuffing plastic waste inside a bottle.



Any food residue on the plastics will produce methane which can be explosive. For this reason it is important to clean and dry the flexible plastics before stuffing them into the bottles.

Always wash your hands after handling any kind of waste.

Use gloves to protect your hands from any sharp edges.

If you are using ecobricks to construct a building, always work with a construction engineer.

Making an ecobrick

To make an ecobrick, wash and dry flexible plastic waste and stuff it tightly into a plastic bottle using a stick. Replace the lid. The ecobrick should be as solid as a brick. On average, 100 plastic food wrappers fit into a 600ml bottle.

Make hundreds or thousands of ecobricks. Use them vertically as the in-fill for timber-frame buildings, or horizontally, mortared together with clay or cement. To collect enough ecobricks to build with, you might like to involve many people in the community. This can take time, so be patient.

Timber-framed ecobrick building (*adapted from BottleSchools.org*)

Firstly, check that you have suitable land, funding, community buy-in, masons and materials. Building with ecobricks is not very different from building with regular materials, using post and beam construction.

The key differences are:

1. A lot of plastic bottles and plastic filler waste need to be collected to make enough ecobricks, which will be used in place of standard building blocks or bricks.
2. You need to insert pins (short pieces of rebar) into the columns and beams before the concrete sets. You can then attach the chicken wire to the pins.
3. Tie ecobricks to the chicken wire, row by row, and then stretch another layer of chicken wire over the other side of the ecobricks.
4. Adding a cement finish means you can't even see the bottles. You might want to leave an "honesty window" to show people it really is made of plastic bottles!

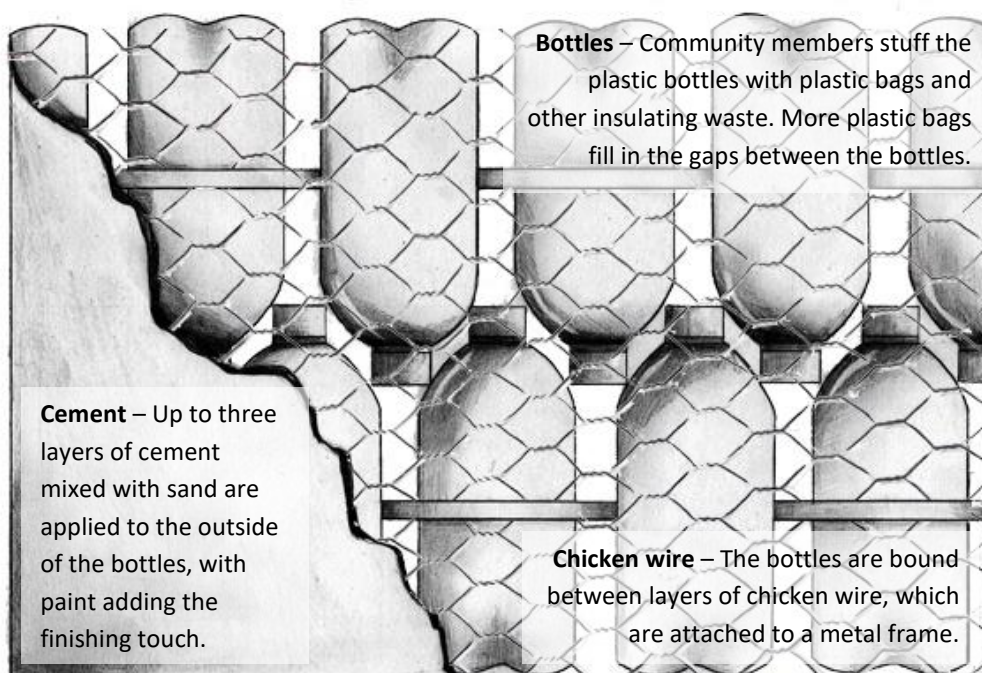


Figure 2: Timber-framed ecobrick building.

To make the bottle walls, stretch a length of chicken wire tightly between two columns, and attach it securely to the pins on the frame of the building.

Then, tie upright ecobricks to the chicken wire in rows, making sure to keep the bottles tightly secured to the chicken wire. Stand the bottles facing up for the first row, then facing down for the second row, fitting the lids in between the gaps as in Figure 2. Once all the bottles are in the wall, stretch another layer of chicken wire over the other side of the bottles, sandwiching the bottles in between the chicken wire. Fill any gaps between the bottles with more plastic waste.

Finally, apply three layers of cement (about 2.5cm in total) on both sides of the bottle walls. Make the final layer a smoother layer to present an attractive finish, and paint it.



Make sure that you have strong concrete and rebar foundations – check with a structural engineer that they are suitable for your soil type and other conditions.



Glass bottles can also be used in construction, using the mortared (cob) method. Glass bottles are stronger than plastic bottles so do not need to be filled. Different colour glass bottles create an attractive light inside a building.

Mortared (cob) ecobrick building (adapted from Ecobricks.org)

1. **Soil test:** Test the earth that you will use for your construction. Choose an earth with high clay content that sticks together when you squeeze it. Every clay/earth is different so you will need to experiment to find the best combination of sand and clay to use for the rest of your construction.
2. **Setting a safe work space:** Clear the space where you will be working of all hazards. Make sure there is plenty of free space to work and move.
3. **Laying the draft foundation:** Lay out your ecobricks on the ground to sculpt the footprint of your construction. This will help you determine the curves and shape as well as how many ecobricks you will need.
4. **Digging out the foundation:** Remove your draft ecobricks from the footprint you have marked out. In their place dig a trench 10 cm deep. Fill this with medium sized stones.
5. **Cementing the foundation:** Mix a rough cement mixture at 1 part cement: 10 parts sand/gravel. If you do not have sand or gravel you can use broken and crushed glass in place of the gravel. Pour the mix over top of the stones. Allow for 5 centimetres of cement above the rock tops.
6. **Laying the bottles:** Lay the ecobricks (those you used for your draft foundation) into the concrete. Ensure that only a maximum of 75% of the bottle is covered. Let the cement dry.

7. **Making the cob mix:** Mix your cob to the ratio that you discovered was best in Step 1. Use buckets to measure each part. Dump the buckets of sand and clay onto a large tarp. Add your organic binder (straw, hay, coconut fibre, etc...). Use your feet to mash and mix the cob. Add small quantities of water as you go to help the mixing (but not too much or your mix will be too soupy).
8. **Making the balls:** You will know that the mixture is complete when you can no longer see any sand and the entire batch is of the same consistency. Have your team make balls out of the mix– this is the last step in the mixing and compaction of the batch.
9. **Laying the bottles:** Bring the balls over to the construction. Bang them down onto the concrete layer. Cover with a layer of compacted cob approximately 5cm high. Then, lay your next row of bottles. Lay each bottle in between the two below it.
10. **Applying more cob:** Once the bottles are snug in the lower cob layer, fill in any large gaps between bottles (for example, on curves) with stones. This will help your cob mixture go further. Fill in with cob between the bottles. Add another layer of 5cm on top of the bottles.
11. **Building up:** Keep adding layers of bottles and cob! To make a bench you will need two or three layers of ecobricks. For walls, it is advisable to add a row of iron bar at every 5th layer of bottles.
12. **The outer skin:** There are many ways to render or cover your cob mixture to make it strong and water resilient.
 - Add cement to your cob ratio so that it is 20% of the mix. Mix in the same way as before. Apply to the outer layer.
 - Paint on a clear acrylic water proofing paint.
 - Paint on a layer of fresh cow dung combined with 10% fine clay.
 - Paint on a layer of lime render.
13. **Finishing the top:** For benches you will want to add a layer of cement for sitting upon. Mix cement at 1 part: 6 part sand. Apply at a minimum thickness of 10 cm.
14. **Finishing with broken tiles:** Use broken tiles to make a pattern on your bench top. Lay tiles out on a long board first in the desired pattern. Have the pattern ready when laying the cement for the bench top. While the cement is still wet, press the broken tiles half way into cement. Once semi-dry, use a trowel to cover with a layer of fine cement (1:4 mix). Use a wet sponge to continually wipe clean.

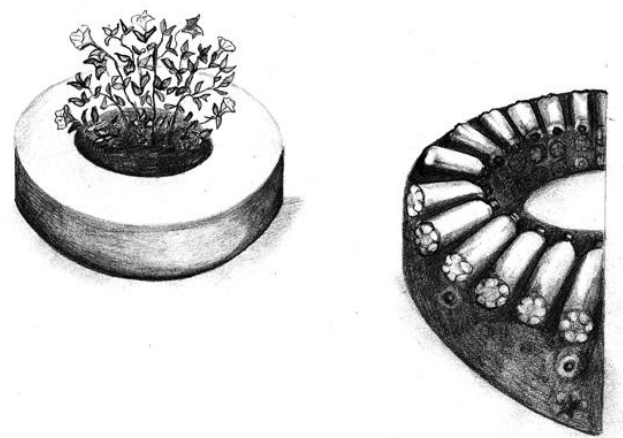


Figure 3: Curved walls can withstand strong winds.