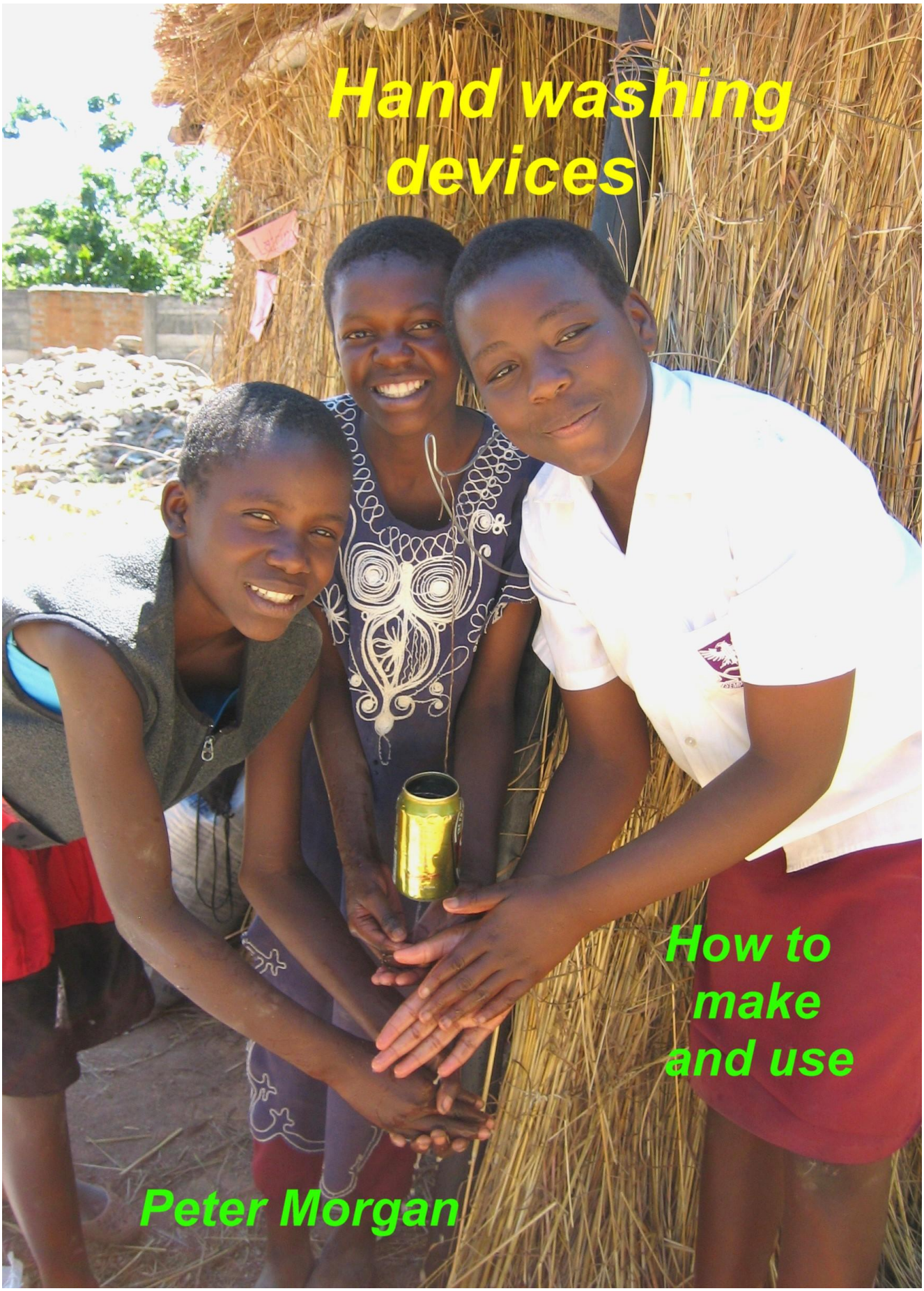
Hand washing devices
How to make and use
Peter Morgan

The importance of hand washing – and introduction

For most people living in the developed world, a tap can be found close by to almost every toilet. There is a tap in almost every kitchen and bathroom. The toilet and tap are united to form an essential couple. The implications are enormous. Water flowing from the tap cuts the cycle of disease through the act of hand washing. Sadly that is not the case for most of rural Africa and much of the developing world. Toilets are built in great numbers, but hand washing facilities available nearby may be scarce. Soiled hands carry disease on bacteria. The cycle where bacteria are passed from hand to mouth is a deadly one.

There are few things related to health more important than hand washing. Simple hand washers, like some described in this booklet, are easy to make and cost almost nothing. They can be placed in several places in the garden or home – near a toilet or in the kitchen. They are economical in their use of water – a precious commodity. Inside the home, soap can be placed nearby. In the garden even wood ash, which acts as a mild abrasive and is slightly alkaline can be effectively used if there is no soap. The construction and daily use of these simple devices can make a huge difference to the health and wellbeing of an individual or a family.

The importance of effective hand washing has been taught for decades by staff of the Ministry of Health in Zimbabwe. Amongst several other developments, this led to a change of habit from using a communal bowl for hand washing prior to meal time, to the use of "pour fresh water over the hands" technique. The wash water, caught in a bowl was thrown away to waste. This single change of hand washing technique had a huge and positive effect on reducing the passage of potentially harmful bacteria from one person to another.

The design of the hand washing device will depend on many factors, not least where they will be used. Those designed for families are simpler and much easier to make than those designed for schools or public places. For many years hand washing devices of several types have been promoted in the Zimbabwe rural water supply and sanitation program. Many Blair VIP toilets are fitted with hand washing tanks and hand washing tanks have been built at schools as an integral part of the Government of Zimbabwe's School Sanitation Program. As part of an ecological sanitation pilot study undertaken at the Chisungu Primary school in Epworth, close to Harare, school children are taught how to make simple hand washing devices which they can use in their own homesteads.

And it is not only in the rural or peri-urban setting that such home made hand washers can be useful. All the main cities and towns of Zimbabwe are also short of water, and these simple devices can find a place even in the most luxurious of homes. The simple and elegant washer made from a "mazoe" bottle placed over a washing basin, can make hand washing possible, when opening a tap does not provide water.

The information in this simple booklet has been accumulated over many years by the writer, from the early days of the Blair Institute, of the Ministry of Health and Child Welfare to later days working with Mvuramanzi Trust and other NGOs. The support of Ephraim Chimbunde and his staff are all gratefully acknowledged. Annie Kanyemba has played a big part in promoting the use of hand washing devices at schools. We thank SEI Stockholm for their support of the program of promoting improved sanitation and hygiene in the school environment. The school is perhaps the very best place to promote the importance of hand washing and teaching the simplest methods of making hand washers to the pupils.

Peter Morgan
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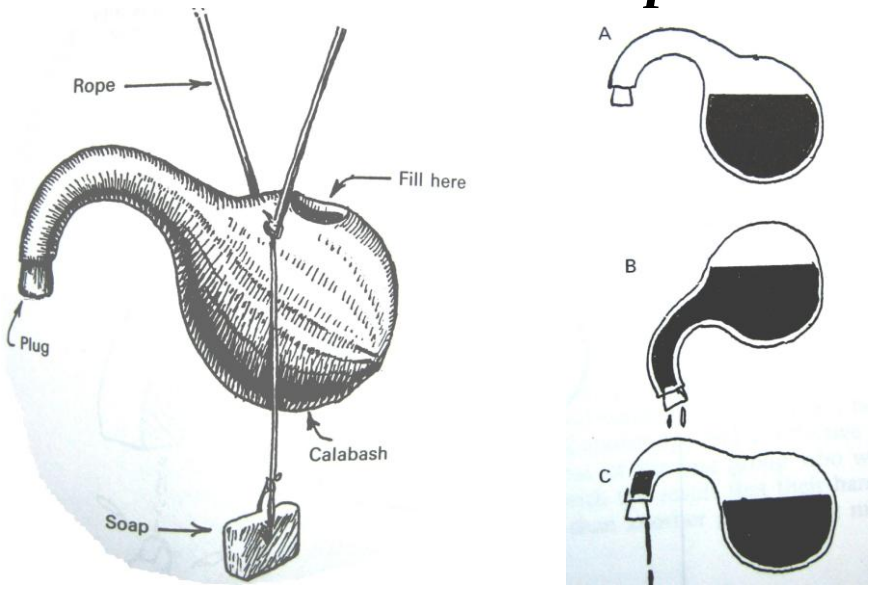
Early hand washing devices in Zimbabwe

Over 30 years ago, Dr Jim Watt, a salvation army doctor working with Jackson Masawi in Chiweshe, devised a remarkably novel hand washing device, known as a Mukombe. This vegetable had a hard shell and could be used as a gourd or calabash for carrying water and other commodities. It is commonly grown in the fields. The great innovation was to turn this common plant into a hand washing device. This innovation was one of the very first hand washing devices which became known as "tippy taps."

The Mukombe

How it works – a description



Drawings by Jim Watt of his Mukombe

Modifications are made to the naturally occurring Mukombe. An opening is made in the top and a cork or plug is placed at the end of the neck as shown above, with a small opening for water to drain. Holes are drilled into the top of the mukombe and a string passed through. The mukombe is suspended by the string so that it lies at a special angle. The mukombe is filled with water and then tipped up so that some water passes up the neck. When the mukombe comes to its resting position again, some water is left at the end of the neck and slowly drains out. It is this water which is used to wash the hands. The flow stops automatically when the small reservoir in the neck runs out.

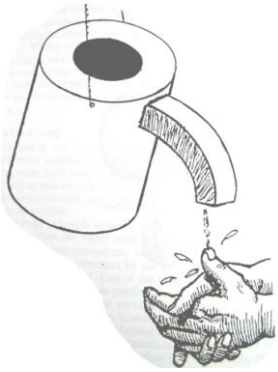
A fibre-glass replica of the Mukombe.

Having seen this remarkable innovation, staff at the Blair Institute built artificial replicas of the Mukombe in fibre-glass to test effectiveness. This was partly because many naturally occurring mukombe gourds did not have the ideal shape. These replicas were designed to provide optimum performance, whilst retaining the same natural appearance. One of the best replicas, shown below, has been preserved, and has a water bowl capacity of 2 litres and a discharge volume (at each tipping) of 50mls. Thus at a single filling it could perform 40 hand washes.


Original hand made Mukombe – built 30 years ago!

Early modifications of the Mukombe in Zimbabwe


Another method, used a standard plastic milk bottle with the hollow handle being modified so it held water which drained from a hole.



Mukombe's were also made in metal. These lasted longer than those made in thin plastic. Durability is an important factor.

Building hand washing devices on Blair VIP toilets

During the expanded rural sanitation program in Zimbabwe, many thousands of BVIP toilets were constructed with hand washing facilities built into them. These were built from bricks and mortar into tanks fitted on the front wall. The water drained out through a small copper pipe fitted with a stopper,

Building the hand washing device on a VIP toilet

Many variations on a theme.

Linking the toilet with the hand washer is important!

Teaching how to make hand washing devices at school

As part of an ecological sanitation pilot study being undertaken at the Chisungu Primary school in Epworth, close to Harare, school children were taught how to make simple hand washing devices which they could easily build and use at home. There are many ways of constructing simple hand washing devices, and their regular use can improve personal hygiene immensely. The aim of this part of the project was simply to show how simple and effective hand washers could be made using discarded cans and plastic bottles. Turning waste products into something really useful. And it works!

Uptake

Many school children have been taught the technique and the methods have been described in school open days and even public events where school children have come together to demonstrate now they recycle "waste" objects including cans and plastic bottles. At a recent event, the children made large numbers of hand washers which were handed out in large numbers to the participants. Once seen the method is easily copied.

It seems remarkable that even in a city like Harare such simple devices can have an important role to play. Running water can be scarce and this is true for much of rural Africa, were the closest supply of water may be far away. In such cases methods which use water economically have great value. If they cost almost nothing to make and suitable hardware can be found nearby, then is makes good sense to teach and promote the simple concepts.

At one open day at the school, the parents and visitors wondered what this hanging can was all about. That was until the little boy dipped that can into water and washed his hands. Then there was an "uproar of delight". Something new and valuable had been taught and passed on. Hand washers can be made from tin cans and plastic bottles and cups.

And Soap?

Soap is thought of as commonly available as bread in most countries, but it is treated with care in Zimbabwe. For many the block of soap is used not only for washing the hands and body but also for washing cloths. In the absence of soap, wood ash makes a fine substitute for hand washing, especially outside in the garden. And for a nation that uses firewood as the most common fuel for cooking there is no shortage of ash. Wood ash washes the hands well, as it works as a mild abrasive when mixed with water and is mildly alkaline. Such a combination is ideal for cleansing the hands and even those harbouring pathogenic bacteria.

A range of options

Until a few years ago, alloy cans were unheard of in Zimbabwe, but now they litter the streets and dumps in their countless thousands. The same held true for coke bottles that were once made of glass. Now we have entered the alloy can and plastic bottle age - plastic bottles used to market soft drinks are also abundant. But with knowhow, that this "garbage" can be turned into something really useful. The hand washer is one of the best examples. There are many types.

The plastic bottle and alloy can technique

This one is popular and only takes a minute or two to make. First, the can top is removed with a can opener. Then three holes are made in the can. Two at the top to take a wire handle, and one at the base to release the water. The holes can be made with small nails (2 – 3mm).and a hammer and are offset as shown in the photos. Some wire is cut and passed through the two upper holes and twisted to form a handle with a hook on the end. This is hooked up to the toilet or a tree or some other stand near the toilet (which is outside). This technique works by dipping the hand washer to a container of water, hanging it up and allowing the water to drain over the hands. Used water can drain over flower or herb beds. Suitable containers can be made of 10 litre buckets, but these are in great demand. Heavier clay pots and other vessels can also be used to hold the water.

Making a simple hand washer from plastic bottle ("dip technique")

There are several types of simple hand washer. This one uses a plastic bottle. Cut the bottom off about one third up. Make a hole in one corner of the base near the edge with a sharp nail or sharpened piece of wire.

Wrap some thin wire around the bottle and hook up to part of the toilet. To use the washer it can be dipped into a container of water on the ground or some water from another bottle can be added to the washer. The water comes out slowly, but it is sufficient to wash the hands. It uses water economically. Alloy cans can also be used. This is described next.

Making a simple hand washer from an alloy can

Take an alloy can (coke etc) and take the top off with a can opener. Make two holes with a nail at the top of the can with a nail and another hole half way between these holes at the base of the can.

The can is placed over a log or pole which makes the hole easy to make with a nail. Two holes are made on either side of the can at the top. Then a single hole is punched into the base of the can in a position between the two holes at the top of the can. A good nail diameter is 3mm.

A length of wire about 30cm long is then taken and passed through the two holes at the top of the can. The wires are twisted together behind the can as shown. A loop is made at the end of the wire. The hand washer is hung from another wire attached to the toilet roof.


A container of water is required as a source of water. The hand washer is dipped into the water and then hung up on the wire hook. Then hands can be washed. A bowl of flowers or herbs can catch the washing water.

The water container for hand washer

The hand washing device requires a container of water beneath it from which to charge the washer. This can be made from a traditional pot or a bucket. To make a more permanent fixture the bucket can be mounted in a concrete base. The hand washing device can be hung on a wire hanging from the roof of the toilet or can be mounted on a wire attached to a pole mounted in the ground.


Hand washing device suspended on a wire fitted to the gum pole of an *Arborloo*. The water container can be a traditional clay pot or a bucket. Alternatively the hand washer can be suspended from a wire frame attached to a pole placed in the ground.

Mounting the bucket


The plastic bucket is placed in a suitable position just outside the toilet next to the place where the hand washer hangs. The bucket is then concreted in position as shown. Bricks are laid around the bucket and the space between the bucket and the bricks is filled with concrete. This is finished off neatly.

Soap or wood ash?

Soap can be drilled with a hole and hung on a wire from the toilet roof. Also a wider tin container can be attached to the side wall of the toilet and filled with wood ash. The fingers are wetted first, dipped into the ash and then washed again. It is a very effective and simple method of washing hands.

Watering a flower garden or tree with the hand washer.

The waste water which pours from the hand washing device washes the hands and then falls to the ground. It is a very good idea to use this water to irrigate flowers or a tree. A small garden of flowers or a pot of flowers or herbs can be placed under the hand washer so they are regularly watered. A tree can also be watered from the hand washer. In this case the tree is best planted to the side of the toilet.


Small gardens of flowers or herbs beneath the hand washer

Hand washers can be made from many plastic bottles, cups and containers

Passing on the message about hand washing devices

Making simple hand washing devices is very easy and discarded cans and bottles can be used. Hand washers like the simple ones described here are easy to make and cost almost nothing. The regular use of these simple devices can make a huge difference to the health and wellbeing of a family. The photos below show pupils of the Chisungu Primary School Epworth, demonstrating these techniques to several hundred school pupils at an exhibition held at the Mukuvisi Woodlands Association in Harare. The Chisungu pupils won a prize for their exhibit for their demonstration of hand washing and the *Arborloo.* The *Arborloo* is used in the woodlands wilderness area.


The pupils prepared large numbers of hand washers


Hundreds of pupils from other schools were shown how to make them.


A practical demonstration of the *Arborloo* was also given

Other valuable hand washing devices for the home

Screw cap bottles

And it is not only at the rural or peri-urban school that such hand washers can be used. The main cities of Zimbabwe are also short of water, and these simple devices can find a place even in best of homes. For the homestead, even in the city, where a tap has been fitted but no longer yields water (not an uncommon situation in Zimbabwe) the ideal hand washer consists of a **round** plastic bottle fitted with a screw cap. The type with a little ribbing helps as this is firmer. Only one thing needs to be done, and that is making a small hole near the base of the bottle. This can be made by heating a steel nail (about 2 – 3mm in diameter) and pushing it through the plastic at some point on the lower rim. The bottle is washed and filled with water and the cap screwed back on. This can be placed on the hand wash basin or hung at some convenient point. As long as the cap is screwed up tight water will not drain from the bottle through the hole. But as soon as the screw cap is loosened water will flow. Air entering to top allows water to drain from the hole. Quite simple and it works. A 2 litre bottle full of water is enough to wash many dirt hands. Small leaks, which slowly let in air through the basic cap be stopped by cutting a small disc of rubber and inserting it within the cap.

Making a simple hand washer from plastic bottle

("screw cap" technique)

In this method the airtight seal made by the cap of a plastic bottle is used. The plastic bottle should have firm sides and ribbed bottles may be best. A small hole is made in the lower part of the bottle with a heated nail 2 or 3mm in diameter. The smaller the hole, the more economical the hand washer become in terms of using water. The unit is filled with water and the cap done up tight. When the cap is unscrewed water flows from the hole for hand washing. When the cap is done up tight the water flow stops.

A variety of bottles can be used. Choose one with reinforcing ribs. They hold their shape better.

Heat a 3mm nail over a flame and carefully push into the base of the bottle. The will leave a small hole which will allow water to flow out later at a controlled rate.

Improving the air tight seal on the cap

The standard seal between the cap and bottle is good, but over a course of days, if the bottle has a hole in its base, small amounts of air will pass through the cap and the bottle of water will slowly drain. In this case a disc of rubber cut from an old bicycle or car inner tube can be cut and inserted into the cap. Then this is screwed down on to the bottle, a better seal is achieved.

A disc of rubber is cut from an old car inner tube and pushed into the cap to make a better seal

Two hand washing bottles set up on a hand washing basin. The taps do not deliver water, but the bottled do. One is covered with a dark shade cloth to prevent algae growing in the bottle.

The screw tap hand washer delivers a good stream of wash water

Communal hand washing tanks at school

Large numbers of schools have been fitted with communal hand washing facilities. These generally consist of brick tanks raised on a brick base and fitted with a tap. Some taps are fitted with water restrictors to reduce the flow. Since most tanks are filled with water by hand the economic use of water is essential. In each case waste water is led through a water run-off down a spillway to a seepage pit or soak-a-way. Water hungry plants can be placed in the seepage area – like bananas, reeds or cane to suck up the waste water.


School tanks being built as part of an Mvuramanzi Trust project.


Teaching children about the importance of hand washing and hygiene is very important – even when they are very young.

WASH YOUR HANDS
Learn at a very young age!

Later designs for school hand washing tank

If the full hygienic benefits are to be gained from the use of school toilets, then some form of hand washing device must be available nearby. This is true in the all settings, including family, community and school. However hand washing devices use water and water must be available so that what ever hand washing device is used (and there are many designs) the practice of hand washing can continue. Many hand washing devices of various types are used in the Zimbabwe WASH program. Many are placed in schools or clinics and others at household level, often attached to a Blair VIP toilet.

The economic use of water is critical. Hand washing devices should not leak and should use water in an economic way. By doing so, the maximum benefit can be made of each litre of water used. In fact hands can be washed adequately using very little water, although of course this depends of how dirty the hand may be at washing time.

The hand washing tank described here has been designed for schools. Conventional taps are used but a water restricting device has been added to reduce the flow of water. This economises on the use of water. In addition the taps have been adapted, with "sprags" welded to them, so the taps will not go missing. The tank itself can be constructed in various sizes. The one described is quite small, but by using the water restricting unit a tank full can last a week or two for a block of toilets.

Stages of construction

The hand washing tank is placed in a suitable location near the school toilets and on the way back to the classroom.

1. Casting the base slab

The base slab is caste in concrete with plenty of reinforcing wire used. In this case the base slab was caste 1.4m in diameter and 75mm thick using a mix of 25litres Portland cement and 125litres of sharp clean river sand. If small granite chips are available, half the sand can be replaced by the chips. The ground is wetted down first and half the concrete is placed in the mould (which can be metal shuttering as shown below or a ring of bricks). The reinforcing wire can be 3 mm and 4mm thick or barbed wire placed in a grid formation about 15cm apart or from pig wire. The slab is smoothed down and left to cure for a week. A plastic sheet is placed in top and the slab is kept wet all the time so that it can cure properly.


The strong base slab (diameter 1.4m) is caste in a suitable position

2. Making the cover slab

In this case the cover slab is made 1.2m in diameter with a hole caste in it for water access. A mix of 12litres of Portland cement and 60 litres of clean sharp river sand is used. The water access hole can be made with a special steel mould, as shown, so that a hole is surrounded by a raised rim. This will allow a cover to be fitted later which is hygienic and raised above the cover slab level. Once again plenty of reinforcing wire is added, as with the base slab. The cover slab is left to cure for at least a week under plastic and is kept wet all the time after hardening. All concrete work should be well cured. The cement used should be Portland Cement (PC15).


The 1.2m diameter cover slab being made


After curing the cover slab is lifted and moved to the tank site. The underside is washed down.

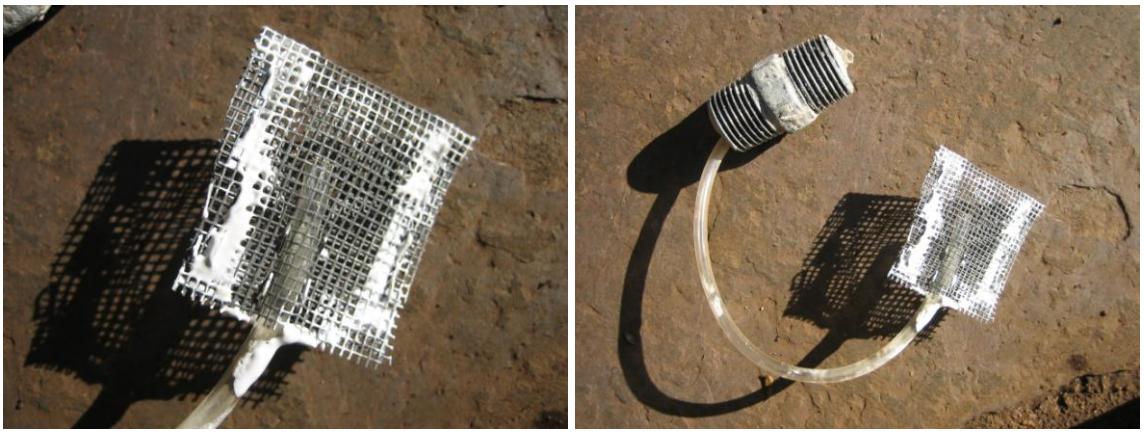
3. Preparing the modified taps and water restrictors

This hand washing device is designed to limit the use of water for hand washing and water restrictors are added to the steel piping which passes through the brick wall of the tank In this case the steel pipes which passes through the tank wall have been made up of a series of 20mm steel sockets and barrel nipples as shown in the photos. The assembling galvanised pipe fittings are fitted to a tap on the outside and to the water restricting device on the inside of the tank. The water flow restrictor itself is made froma short length (about 200mm) thin plastic tubing used to deliver sterile water or Ringers solution in drip feeds used in clinics and hospitals. The clinic should have discarded tubes. The plastic tube has an internal diameter of 2.5mm. The narrow diameter of the tube restricts the flow of water to the tap. One end of the tube is passed through a 20mm steel barrel nipple as shown in the photo and is embedded in hard setting epoxy putty (such as Pratley). The barrel nipple will be screwed into the 20mm steel socket fitted on the inner end of the pipes which pass through the tank wall. To protect the narrow plastic tube from being blocked by small items which may accidentally enter the tank a durable screen is added around the end. In this case it is made from a small piece (50mm x 100mm) of PVC coated fibreglass screen material. The openings of this screen are 1.5mm X 1.5mm, and thus prevent small items blocking the pipe. The screen material is folded and clipped with staples and then held together with Pratley quickset white epoxy. .It is sealed around the plastic pipe. The pipe unit which passes through the tank wall is about 120mm long so it protrudes slightly on the inside and outside of the brick wall after plastering. In this case 4 taps have been fitted to the tank

The brass tap is a standard unit, but experience has shown that it is desirable to anchor the tap firmly into the tank wall with cement mortar. Steel sprags are carefully welded to the tap, so that it can be plastered in position firmly on the outer tank wall after it is screwed into the steel pipe fitting.


In this case a series of 20mm steel connectors and barrel nipples were screwed together to fit through the tank wall. Pipe sealing compound was used on the joints. The brass tap fitted with sprags to avoid loss of the tap due to theft.


The thin plastic pipe is inserted through the barrel nipple and sealed and held in place by a hard setting putty such as Pratley epoxy.



The PVC coated fibreglass screen measuring about 50mm x 100mm is folded and clipped around the pipe and then secured with Pratley white epoxy. On the right the complete water restrictor and protective screen.

4. Building the walls (first 30cm)

The walls are built up in brickwork as shown, using a strong cement mortar (1 parts Portland cement and 6 parts pit sand. The brickwork is built up to 30cm above the base of the tank. At this level the steel pipes are added through the tank wall.

The first three courses of bricks are laid down with an external diameter of 1,2m in strong cement mortar.

5. Adding the steel pipes through the brick wall

The steel pipes are now added through the brick wall in strong cement mortar

The steel pipes are laid through the brick all above the third course of bricks. A strong cement mortar is used to bond the bricks around the steel pipe. The pipes are placed on one side of the tank. A water catchment area is built beneath the taps which lead to a water run-ff. The steel pipe should protrude slightly from each side of the brick wall.


After the pipes are inserted in the cement mortar the brick wall is continued up.

6. Completing the brick walls

The brick wall is continued up to a height of about one metre (about ten courses of brick work). It helps to add a wire loop within the brick mortar a course above the water outlets and then half way between this level and the top of the tank. These add strength to the brick wall once the tank is filled with water.


The brick tank is built up to just over one metre high. The actual size of the tank is not specific. Larger tanks with greater capacity can be built.

7. Making the water run-off

At the same time the water run-off leading water from the hand washing area must be made. This can be made from bricks and a strong concrete filler is laid down within the bricks to make a water run-off which directs the water away from the tank into a seepage area. A water catchment area below the taps is an extension of the base slab, which helps to direct water into the run-off.


8. Plastering the walls of the tank

The walls of the tank are now plastered with a strong mix of Portland cement and pit sand (about 1:4), both inside and outside. A commercial water proofing additive (such as Non Porite from Prodorite) can be added to the mix to reduce leakage. This is allowed to cure. It helps to cover the tank with a large plastic sheet to avoid rapid drying of the plaster. Once the plaster work has set hard – overnight – it is best to keep it wet at all times. Concrete work and plaster work develops far greater strength during the curing stage, which can last for up to a month or more. During this stage the cement or concrete work should remain wet. If newly made mortar or concrete work is allowed to dry out before it has been properly cured, it will never develop the strength that is required.


The walls of the tank are plastered inside and outside

9. Adding the water restrictors inside tank

The four water restrictors are now added to the inside of the tank. With all joimnts it helps to stop leakage of a pipe joining compound, tape or hard setting resin is used to ensure all joints are water tight.


The water restricting units inside the tank

10. Adding the tank cover

Once the mortar is cured and the water restrictors added the tank cover can be fitted on the tank and cement mortared in position. A mortar seal should be made between tank walls and cover.


Adding the concrete cover to the tank

11. Adding the taps

The four taps are then screwed into the pipe sockets and made watertight with pipe sealer or pipe tape. Then strong cement mortar is applied around the taps against the wall of the tank. This mortar helps to secure the tap to the tank permanently. Tap washers can still be removed and replaced from the tap by undoing the appropriate threading on the tap. Robust brass taps should be used as they will be heavily used. Pupils should be shown the unit and told about its correct use and the need to close off the tap once the hands have been washed. Even a tap which releases a little water will empty the tank over a weekend of the tap is left running.


The tap is fitted and the securing mortaring being made


The tap mortared in position. The mortaring was undertaken by a student at the school. Students have been taught how to make toilets and hand washing devices in Epworth

12. The lid and adding water

A matching lid is made in concrete (with a handle) to fit within the raised collar on the cover slab (as shown). Water is added from the school hand pump or from other courses. If a tap is available at the school, water can be piped into the tank. Otherwise water should be added from what ever source is available.

13. Water Quality

If there is doubt about the quality of the water, a small amount of chlorine in the form of alginate, (one local product is SPAR Swimming Pool Chlorine) HTH or chloride of lime, should be added to the tank. Five grams (full teaspoon) per tank of alginate is more than adequate for a 1 cu. m. tank. This can be dissolved in a bottle of water first, then added to the tank as it is being filled. In fact adding a low dose of chlorine to water in the tank on a regular basis may be a good alternative to providing soap, as residual chlorine left on the hands may reduce bacteria levels. But the level of chlorine must not be high, as this will leave an unpleasant smell on the hands. Soap left in such places as school hand washing tanks has a habit of vanishing!


13. Finishing off

The water run-off leads water to a seepage area. This can be a hole filled with compost and planted with plants which soak up water. Bananas, sugar cane and other water thirsty plants can be used to soak up excess water flowing into the seepage area from the hand washer.


Daily use

Once the tank has been filled, the device can be used to wash the hands after the pupils have visited the toilet. The rate of flow of the water is variable and depends on the height of the water above the tap. It is usually a small stream of water. Between 50mls and 100mls of water will be required for hand washing. But this will be very variable depending on how long the tap is left open.

Placing soap at the hand washing site, may only be a temporary solution. Placing a box of wood ash at the site may be something worth trying, although once it becomes wet it is more difficult to use. A mild disinfectant, like chlorine added to the water, may be affective, as described earlier.

It is important to keep the area clean and tidy. Pupils should be taught by the teachers the importance of hand washing and how to use this unit economically.

This design is still experimental and on trial in Zimbabwe


In this design the taps are placed low down in a tank which is built up from ground level. This makes the construction simpler compared to those tanks mounted over brick bases built above ground level. The dimensions of this tank can be very variable, and larger tanks will require filling less often. It is a case of matching economy and usefulness. Tanks should be made in such a way that they require very low levels of maintenance.

WASH YOUR HANDS

by

Making your own hand washing device!

Join the club of those who have made their own hand washer!