ideas to impact.

WATER FILTRATION & PURIFICATION SYSTEM

ENERGY ACCESS |
LPG CYLINDER PRIZE WINNING SOLUTION (1/7)

SEPTEMBER 2017

ABOUT IDEAS TO IMPACT

Ideas to Impact is an action-research programme designing, implementing and testing innovation prizes, to induce innovative solutions to development challenges in Climate Change Adaptation, Energy Access and WASH. A five year, £10.9m programme, funded by the Department for International Development (Dfid) that supports research and development in climate change, energy and WASH through a variety of innovation prizes. The prizes are designed to stimulate and incentivise development of technologies for low income consumers that will improve poor people's access to affordable clean energy, safe drinking water and resilience to climate change.

ABOUT THE ENERGY ACCESS: LPG CYLINDER PRIZE

As part of the Ideas to Impact the Energy Access: LPG Cylinder Prize launched on July 7, 2015, focused on inducing innovations for recycling liquid petroleum gas (LPG) cylinders across sub-Saharan Africa. Applications were received from more than 180 solvers, from over 40 countries, proposing solutions to address the problem of how to maximise the value of large numbers of aging and unsafe LPG cylinders that might need to be retired in the event of market reforms. No readily available solution which could be implemented at scale was identified. However, seven winners were selected, who offered solutions which in the view of the judges had potential to address the challenge subject to further research and development.

Here we share one of these winning solutions.

ACKNOWLEDGEMENTS

The Energy Access prize is led by Simon Collings at Energy 4 Impact, and collaboratively designed with Jonathan Slater from The Blue Globe.

Ideas to Impact is managed by IMC Worldwide Ltd. With special thanks to the independent panel of judges who judged the winning solution.

Water Filtration & Purification System

DESCRIPTION: Propane tanks that are identified as necessary to be removed from circulation are converted into a water filtration & purification system that uses local materials, is reuseable, and scaleable. Rather than scrap these unusable propane tanks, they are turned into a valuable addition to the community and home to provide filtered & purified clean water suitable for human consumption.

THE CHALLENGE: Recycle old propane cylinders that cannot be re-certified and put back into the Liquid Propane Gas (LPG) distribution market. Identify a new, creative, and high-value application for these cylinders, that brings about safety, environmental, economic (e.g. job creation), and social benefits.

BACKGROUND: Life cannot exist without water.

"The situation of access to clean water and sanitation in rural Africa is even more dismal than the previous statistics imply. The World Health Organization (WHO) (2006) stated that, in 2004, only 16% of people in sub-Saharan Africa had access to drinking water through a household connection (an indoor tap or a tap in the yard)."

The implications of lack of clean water and access to adequate sanitation are widespread. Young children die from dehydration and malnutrition, results of suffering from diarrheal illnesses that could be prevented by clean water and good hygiene (Metwally, Ibrahim, Saad, & Abu El-Ela, 2006). Diseases such as cholera are spread rampantly during the wet season. Women and young girls, who are the major role-players in accessing and carrying water, are prevented from doing income-generating work or attending school, as the majority of their day is often spent walking miles for their daily water needs."Reference: http://thewaterproject.org/water-in-crisis-rural-urban-africa

"115 people in Africa die every hour from diseases linked to poor sanitation, poor hygiene and contaminated water. " Reference: http://www.un.org/waterforlifedecade/africa.shtml

In order to fully understand the magnitude of the drinking water problem in Sub Saharan Africa, the following web links are provided. These links provide detailed analyses and charts

regarding access to improved (clean) water for rural, urban, richer and poorer populations across Africa.

The key takeaway is that in 2010, 23% of people (230 Million) in Africa used an unimproved water source for drinking. Most of Sub Saharan Africa is not on track to meet goals for improvement to these statistics.

References:http://www.wssinfo.org/fileadmin/user_upload/resources/Africa-AMCOW-Snapshot-2012-English-Final.pdf

http://www.wssinfo.org/fileadmin/user_upload/resources/1251454622-A_Snapshot_of_Drinking_Water_in_Africa_Eng.pdf

The abundant need for clean water (especially in remote rural areas) is the motivation for this water filtration and purification system proposal. Combining the natural resources on hand in Sub Saharan Africa with the abundance of LPG tanks, it is proposed to make a natural water filtration and purification system. This will serve to prevent people from drinking from unimproved water sources.

SOLUTION REQUIREMENTS:

1. Irreversibility of new non LPG Cylinders: This proposed solution involves the complete destruction of the tank by removing the valve and top, and then drilling holes into the bottom of the tank. This is absolute, one way, and irreversible. This solution does NOT address the refurbishment of propane tanks in any way.

2. **Value:** The ability to create clean filtered water will yield immediate benefits immediately for individuals and families, with secondary benefits to agricultural and animal herding efforts. Health benefits will be the most immediate benefit realized as waterborne illnesses such as dysentery and cholera will be reduced. Less time will be required to transport water from improved sources. Instead, local water sources (even if unimproved) can be used with confidence and without fear of illness, allowing for more time to be spent on farming, herding, family care, and education. All of these will result in increase societal benefits and reduced poverty. Once installed the filtration/purification systems will provide an enduring means of water filtration that will continue to contribute to the region's health, growth and prosperity. The filtration system is completely transportable in small sections and can be brought to any region that is in need due to polluted or contaminated water supply. These benefits will continue

to accumulate over time, thus the value of this concept is easily greater than the single time cost to repurpose the cylinders.

3. Geographical Context: In rural areas, significant amounts of time are spent retrieving water from distant water sources. The water is used for multiple purposes (irrigation, livestock, sanitation) including cooking and human consumption, but there is no guarantee that the water is safe to drink. Even if the water was safe at one time it may have become contaminated when it was stored or contaminated via containers that were used for transport. The burden for water collection falls disproportionately to women and children. A simple water filtration system will greatly reduce the risk associated with unimproved water sources, and also the need to travel long distance to fetch water if a local source cannot be safely used. The availability of clean filtered water will water ease this burden, and ensure that there is enough water for each task, so that all aspects of life are improved.

4. Environmental impact: This proposal greatly reduces the environmental burden. Rather than scrap the entire propane tank, only the top, and valves are recycled. The majority of the tank is used as a container to house the filtration system.

5. Capacity and Inventory: This proposal has the unique capability to convert every non functioning propane tank (estimated to be 1.5 Million tanks in the guidelines of the challenge), regardless of size. All that is required is for similar size (same diameter tanks) to be used together to form stackable sections. If additional tanks are found, the overall capacity to filter water will be increased.

6. Local Resources: This solution relies on conventional metal cutting skills and tools such as: metal cutting tools, drills, blow torches, and grinding wheels. The tank pieces do not need to be cut with any significant amount of precision. Other supplies that are needed include rocks, sand, charcoal, grass, gravel etc, and are found locally. The deployment of the portable filtration system does not require any electricity, and relies only on gravity for the water to drip through and be filtered as it passes through the filter materials.

CRITERIA:

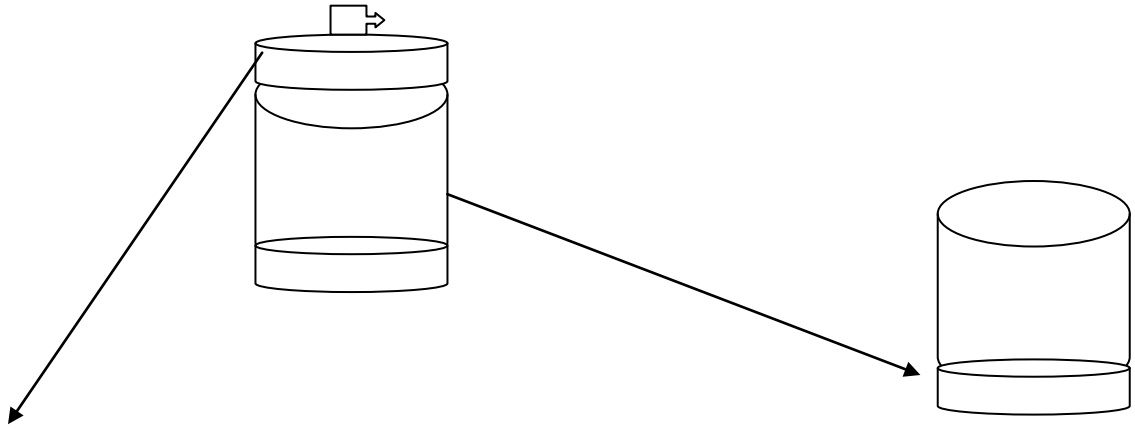
1. Description: This proposal describes a relocateable water filtration & purification system that uses local resources and is expandable in scale. The filtration containers are made from repurposed propane tanks. The system will provide filtered and purified water that is safe for human consumption. The filter system can be made with from two tanks, however the concept can be expanded to include 8 or more tanks to create larger filtration capacity.

1.a New Application

Production: The following steps represent a high level procedure for production of a representative water filtration system. Only basic metal shop knowledge, tools, and skills are used to create the filter tanks, and minimal experience is required to perform these tasks.

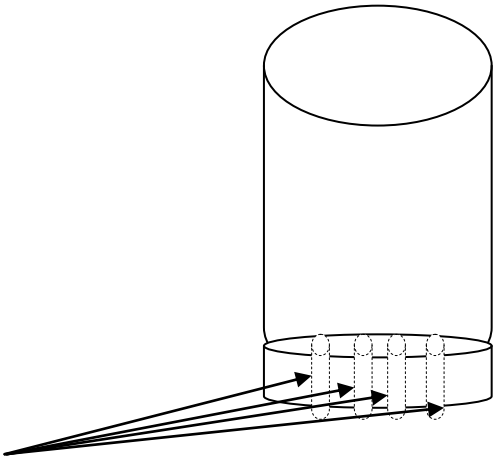
1. Ensure tank is gas free and remove valve. (Refer to Appendix 4 of the "Guide to Good Industry Practices - LP Gas Cylinder Management-2" , provided as part of the instruction set for this challenge). Fill with water and rinse (water can be reused), or use the approved steam cleaning method to ensure the tank is completely gas free.

2. Using metal cutting tool or blow torch, cut off the top section including the shroud ring and recycle these pieces. The bottom portions of the tanks are not cut off. Retain the main cylinder section. Repeat this for two (QTY 2) tanks.



Recycle shroud ring, and valve (from step 1) Retain Main Cylinder Section and base ring

3. Drill small diameter holes into the bottom of one of the main cylinders from Step 2. Some experimentation may be required to determine the optimal diameter and quantity of holes to drill This is the dirty water filter tank. The tank without holes drilled in the bottom of the tank is the filtered water receiver tank.



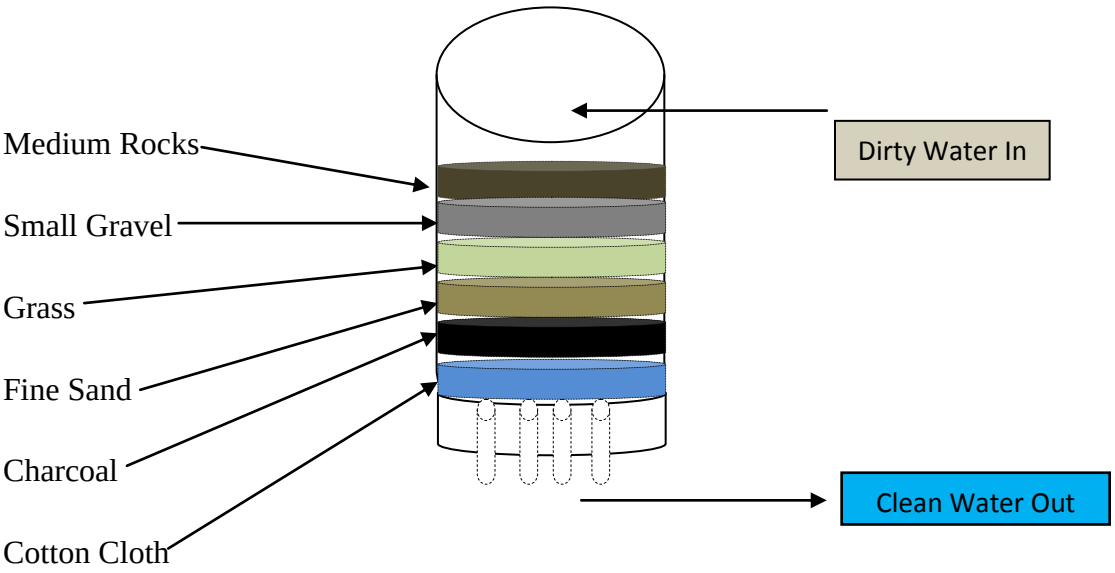
Multiple drain holes drilled in bottom of tank

4. Grind any sharp edges or burrs by using a metal grinding wheel so that edges are smooth and free of sharp edges on both tanks.

5. Loose rust or scale should be removed with wire brush, and parts given a final steam clean wash or degreasing to remove any residues.

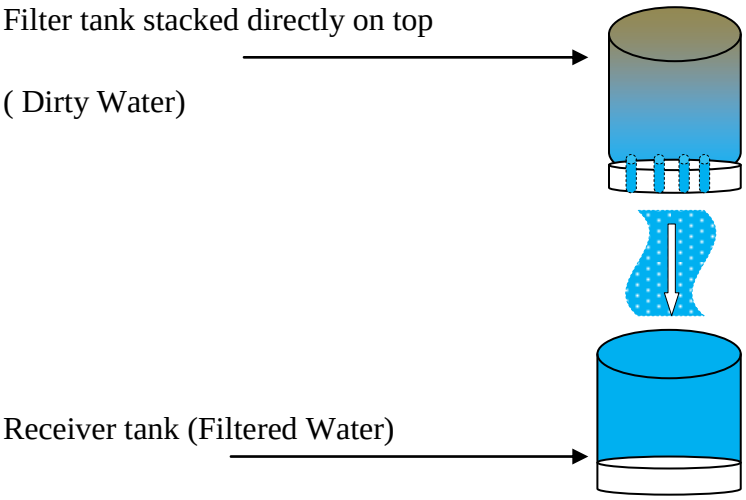
6. Product is ready to repurpose or sell!

7. In order complete the filtration system, local materials are used. Various filter materials may be used depending what is available on hand. If a small patch of cotton cloth is available, that may be used at the very bottom to prevent charcoal or sand from running out the holes. Starting from the bottom, the dirty water filter tank is filled with the following charcoal or fine sand, small gravel or a layer of grass, Medium size rocks). Each layer should be compacted as much as possible.



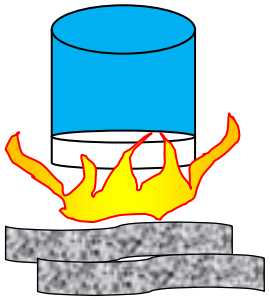
8. Once the filter material is complete, the filter tank is stacked on top of the receiver tank and the filtration process can begin. Slowly pour dirty water in to the top of the water filter. It will filter and percolate down through the bottom of the tank, and drip into the receiver tank. This process may be repeated several times depending how dirty the water was to begin with. Once satisfied that the water "looks" clear/clean, the receiver tank can be removed and placed in a fire to boil the filtered water and create the finished product safe for human consumption.

A diagram is below and may be instructive to include as a decal on the filtration system.



Receiver tank is used to boil water to purify for human consumption

Charcoal from fire can be used to create future filter material



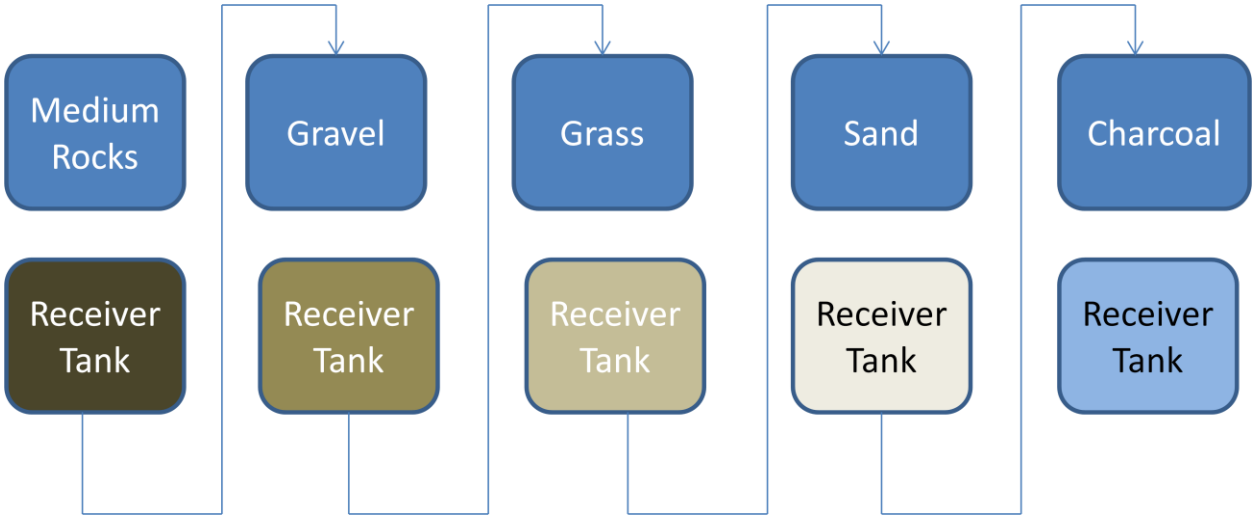
Potential Yield:

Note: This proposal uses the dimensions supplied in the document "Technical Drawings of Cylinders.pdf" provided in the initial challenge guidelines. The 14.5 Kg cylinder dimensions used were an inner diameter of 316 mm (12.5 in), inner radius of 158 mm (6.2 in), and the given height of 653 mm from the diagram was reduced by 180 mm (to account for proposed modifications), which yielded a working height of 473 mm (18.6 in). Table 1 provides the estimated maximum yield of purified water from a 2 tank filtration system

	Gallons	Liters
Volume of Receiver Tank $(3.14*(r^2)*h)= 3.14*(6.2in.)^2*18.6$ in.	9.7	36.6

TABLE 1

Installation and Scaleability: The filtration system can be used as described above, or multiple tanks can be used to create a larger filtration system. Because it will take longer for the water to filter through the sand/charcoal, additional tanks for sand/charcoal stages may be necessary. The filter material should be replaced periodically to ensure proper operation. A simple tally sheet can be used to track the number of cycles, and filter material replace every 20 cycles or whatever is determined determined to be necessary. Trial and error is involved as the filter material could be changed sooner if the filters become plugged, or no longer appear to be cleaning the water).



1.b Examples: There are numerous examples, instructions, and variations on the web to create a homemade water filter. Several web links are included below:

http://theweekendprepper.com/water/how-to-build-a-homemade-water-filter/

https://www.pinterest.com/pin/557250153863613529/

http://www.designweneed.com/biosand-drinking-water-filter/

The one universal item that is necessary in all of these examples is a sturdy container to hold the water and filter material. In addition a, a sturdy, flameproof container is required to boil the water after it has been filtered. This is the perfect use for the repurposed LPG tank, as it can not only hold the filter material and water, but it can also be used to boil the filtered water in order to complete the purification process and ensure the water safe for human consumption.

I am unaware of any filter efforts that have used recycled propane tanks as the container for filtrations or purification process. Water filtration concepts have been used for hundreds of years, and all natural versions continue to increase popularity for use in emergency survival and off grid applications. By using the repurposed sections from the propane tanks, a low cost and permanent solution is provided for indigenous people in rural areas to uses local resources and

make the water filters a reality. Use of local filtration materials is vital for low cost, longer term use, and flexibility in varied regions of Africa and the world.

1.c Benefits: Numerous benefits for filtered and purified water have already been discussed above and in the reference web links**.** Water is life.

2. Work Plan: The following facilities and functions should be created to make this a reality:

Collection center(s) must be used to identify, track (by serial number), store and safeguard propane tanks which are not serviceable. This is to ensure unusable tanks are kept off the market and not reinserted into use.

A fabrication shop must be made where the tanks can be converted as described in the production section above. A simple metal working shop with basic tools is all that is required.

A Demo/Installation/Training team should be created to explain how this product is used, and the importance/convenience of having filtered and purified for human consumption. This education should include all of the tangible as well as intangible benefits mentioned previously and described in detail in the provided web references.

Finally, a distribution or sales team should be available to sell at low cost (or ideally provide these filter products for free to those in need). This would further encourage small farmers, families, and herding communities to make use of the water filtration/purification concepts, and further accelerate the removal of dangerous tanks from the LPG population.

3. Main Costs: The primary cost driver of this proposal is found in the labor to fabricate the filter pieces from the unserviceable tanks. Because the labor involved involves only simple machine shop experience, it is not anticipated to be an exceedingly high cost, but would provide jobs for the local community. The economic, social, and health benefits returned from such an investment represent significantly greater value for the good of the region.

3. Statement of Willingness: As an engineer, I am interested in achieving efficiencies in all areas wherever they may be found. The identification, adaptation, and reuse of existing assets is part of my current job. I am familiar with product development concepts including:

functional requirements definition, technical specifications, prototype creation, collection of user feedback, product testing, and delivery of end product.

I am excited to create something that will help create a better life for those that do not have the most basic of basic needs. I am willing to engage with the seeker for further development of the proposed concepts.

4. Supplementary:

I am motivated to solve problems wherever they may lie through the use of better technology. However, today's modern technology is not helping everyone equally. Technologies and services are available, yet basic needs for millions are not being met in certain parts of the world. Where you live should not dictate if you live, but in many cases it does. Water is essential for life and prosperity. I believe that simple concepts such as ensuring clean, accessible water should be pursued on a global scale. This is a simple concept that can help the widest number of people to obtain more stable, healthier and productive lives.

I am employed as an engineer, working as a civil servant for the U. S. Government. I am applying as an individual, and heard of this challenge through the Innocentive web site.

IMC Worldwide Ltd
64-68 London Road Redhill, Surrey RH1 1LG, United Kingdom
Tel: +44 (0)1737 231400
Fax: +44 (0)1737 771107
Email: imc@imcworldwide.com

Energy 4 Impact
Fifth Floor - Totara Park House
34-36 Gray's Inn Road
WC1X 8HR
London, United Kingdom
Tel: + 44 207 242 8602
Fax: + 44 207 242 8602
E-mail: info@energy4impact.org

This work was supported by the UK Department for International Development, from the UK government, and the Ideas to Impact programme managed by IMC Worldwide Ltd.

info@ideastoimpact.net
ideastoimpact.net
@ideastoimpact