Developing Countries

Procter & Gamble: Providing Safe Drinking Water to the Poor

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Sector • Water
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Summary

Safe drinking water is one of the world's greatest needs, according to the World Health Organization (WHO). More than one billion people lack safe water, and an estimated 1.8 million children die each year because of diarrhoeal diseases due to contaminated water. P&G Health Sciences Institute, in collaboration with the US Centers for Disease Control and Prevention (CDC), developed an affordable and simple in-home water purification product, Purifier of Water (PUR). This innovative powder, sold in individual sachets, reduces pathogenic bacteria and results in drinking water that meets WHO standards. After fruitless efforts to turn this innovation into a for-profit venture in various parts of the developing world, P&G is now promoting it as a successful CSR Initiative, resulting in 57 million sachets sold at cost to humanitarian organizations by 2007 and distributed for profit by local entrepreneurs for the benefits of populations in need. The Initiative also guarantees P&G a strong public profile and provides the experience that will enable the company to sell its product for profit in high-income markets.

The Need for Drinkable Water in Developing Countries

According to the World Health Organization, of the 1.1 billion people using water from unimproved sources in 2002, two thirds live in Asia, and 42 percent of the population is still underserved in sub-Saharan Africa (see Figure 1). Water-borne infections such as cholera, typhoid fever and dysentery also burden the public health system and can have significant impacts: child malnutrition and death, diarrhoeal and skin diseases, parasitic infestations. Two million people die every year from diarrheal diseases, the vast majority of these deaths occurring in children under five years of age. In addition, the impact that emergencies in general and natural disasters such as floods and drought in particular can have on children is broad and serious. These impacts range from immediate short-term effects to longer-term influences on children’s overall mental and physical development.
The gap between urban and rural populations regarding access to safe drinking water is patent: while 92 percent of the urban population in developing countries has access to drinking water sources, the percentage is down to 70 percent in rural areas. Many rural towns and villages need support to improve safe water supply and hygiene, if the MDG aimed at halving the proportion of people unable to reach or afford safe drinking water is to be met by 2015.

In Vietnam for instance, the large public water, environment and sanitation (WES) investments find it difficult to reach poor rural areas. Vietnam has achieved remarkable economic success since the “doi moi” (renovation) process began in 1986. From 1990 to 2005, Vietnam’s GDP nearly tripled. The percentage of poor households decreased from 58 percent in 1993 to 24 percent in 2004 (with a high concentration in rural areas). Domestic resources for development were strengthened. However, rural areas did not benefit from public investment in WES programs as the urban areas did, and poor people in extremely disadvantaged communities still face great challenges, including poor access to safe drinking water. In 1990, only 21.5 percent of the rural population had access to clean water, rising to 44.6 percent in 2000 and an estimated 58 percent in 2004. In 1990, already 45 percent of the urban population had access to clean water, rising to over 80 percent in 2000.

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1 Source: WHO
Introducing P&G and the PUR Concept

OVERVIEW OF P&G

Procter & Gamble (P&G) is an American global corporation based in Cincinnati, Ohio, which manufactures and markets almost 300 consumer goods to more than five billion consumers in 140 countries. P&G employs about 135,000 people in over 80 countries. In 2005, the company recorded revenues of US$56.8 billion.

The P&G Health Sciences Institute comprises more than 200 scientists dedicated to identify, develop and use leading health care technologies in the development of effective products for both developing and developed countries. P&G Health Sciences Institute scientists have been looking for new ways to purify drinking water since 1995. Much of this work has been in collaboration with the U.S. Centers for Disease Control and Prevention (CDC) and the International Council of Nurses (ICN).

INTRODUCTION TO WATER PURIFICATION SOLUTIONS

A complementary approach to providing piped-treated water is through treatment of drinking water directly in people’s homes. A point-of-use (POU) model, combined with safe storage, has two main advantages: ease of distribution relying on logistics instead of piped systems and low-cost compared to building infrastructures.

Simple, low-cost interventions at the household and community levels are capable of dramatically improving the microbial quality of household stored water and reducing the risks of water-borne diseases, even in the absence of improved sanitation or other hygiene measures.

WHO identified five main point-of-use water purification techniques:

- **Chlorination** (adding chlorine in liquid or tablet form to drinking water stored in a protected container). At doses of a few mg/litre and contact times of about 30 minutes, chlorine generally inactivates almost 100 percent of bacteria, provided water is clear.
- **Solar disinfection** (exposing water in disposable clear plastic bottles to sunlight for a day). A combination of heat and ultra-violet radiation from the sun can inactivate pathogens present in water, provided water is relatively clear.
- **Filtration**. Higher quality ceramic filters with small pores, often coated with silver to control bacterial growth, have been shown to be effective at removing many microbes. Filters can have a long life but their up-front cost may be an obstacle to low-income populations.

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2 The CDC is an agency of the US Department of Health and Human Services that protects people’s health and safety by preventing and controlling diseases, providing credible information on critical health issues, and partnering with local, national and international organizations.

3 The ICN is a federation of 124 national nurses’ associations representing millions of nurses worldwide. It is the international voice of nursing and works to ensure quality care for all and sound health policies globally.
Combined flocculation/disinfection systems (adding powders or tablets to coagulate sediments in water followed by a timed release of chlorine). These typically treat ten to fifteen litres of water and are particularly useful for treating turbid water.

Boiling water can kill pathogens effectively. While boiling is widely practiced, it may be more costly, inconvenient and environmentally unsustainable compared to other options, and this method requires access to energy.

Safe storage should also be included in interventions to treat water at home. Most of these solutions need to be accompanied by behavioral change techniques, including social marketing, community mobilization, communication and education. Researchers are finding that many households would be willing to pay for home treatment at an acceptable price (e.g. less than US$10 for water filters in Southern Africa). In order to be successful, a home water treatment system (HWTS) implementation must be effective, scalable and sustainable.

THE P&G INNOVATION: AN AFFORDABLE AND SIMPLE-TO-USE IN-HOME WATER PURIFICATION PRODUCT

The research efforts led by P&G Health Sciences Institute have guided the development of a low-cost and simple-to-use in-home water purification product, Purifier of Water (PUR). PUR required product development and market-based learning costing approximately US$15 million over six years.

PUR is a coagulation, flocculation and disinfection treatment system, all contained in a sachet. A small sachet of powdered product (i) visibly separates the cleaned water from the murky masses while providing residual chlorination; (ii) uses ingredients used in municipal treatment plants including ferric sulphate to remove phosphate and calcium hypochlorite as a disinfectant; and (iii) provides superior performance compared to chlorine alone in turbid waters and reduction of organics as well as heavy metals. PUR also has a long shelf life (more than three years), providing potential for long-term consumer use as well as for providing emergency water.

The water purification process involves a few simple steps (see Appendix A):

- Adding one sachet to ten litres of water and stirring to separate the cleaned water from the murky masses, until water is clear;
- Filtering water through a cloth and disposing separated flocculent in the latrine;
- Letting clear water stand for 20 minutes to allow for complete disinfection and storing it in a suitable container to prevent recontamination.

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4 Coagulation is the process by which a liquid changes to a thickened, curd-like, insoluble state by chemical reaction.
5 Flocculation is a chemical process that causes a dispersed colloidal system (such as clay) to coagulate and form flocs (coagulated masses of particles in a liquid).
6 Disinfection is a treatment that destroys harmful microorganisms.
7 Source: WBCSD, 2006
The Learning Process: From a For-Profit to a CSR Venture

IS THERE A FUTURE MARKET FOR P&G? PUR’S ORIGINAL FOR-PROFIT STRATEGY

In addition to the non-profit activities undertaken by P&G as part of its Corporate Social Responsibility, the company also tried to develop a commercial model for marketing PUR. The commercial model leverages the technology innovation, distribution and marketing infrastructure of the private sector, combined with advocacy, education and research efforts by collaborating groups to build awareness of the need to properly treat and store water.

Commercial test markets were conducted in Guatemala, the Philippines, Morocco, Pakistan and Vietnam. This model requires specific activities, such as a scientific symposium and outreach to build awareness, local training sessions involving village health workers and health intervention trials conducted by the Medical Entomology Research and Training Unit (MERTU) and the Centers for Disease Control and Prevention (CDC). P&G is also collaborating with Johns Hopkins University Communications Program in order to identify the key factors needed to enable long-term consumer habit change needed for POU technologies. Effectiveness of this model would also imply a networking development with P&G’s local distributors and other private companies, which already produce and distribute household water treatment throughout shops and bazaars to ensure the future distribution of sachets.

The packaging of the product in small sachets that sell well in poor countries is also an innovation. They are convenient to store over long periods of time and thus can be kept for emergency use. One small sachet will treat ten litres of water (enough drinking water for an average family for two days). PUR can also be bought in bulk quantities for use such as emergency disasters or miniature treatment plants.

The cost for producing PUR is US$0.04 per sachet. PUR pricing varies from one market to another, based on what the local market is thought to be able to bear. When it was launched in 2000, it was priced for a low-income commercial market between US$0.08 and $0.10 per sachet, an acceptable price according to initial market tests. As Sally Cowal from the Washington-based NGO Population Services International (PSI) explains, “if you pay for something, you’re much more likely to use it than if it’s handed to you.”

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8 See social and emergency models described below.
P&G’S ATTEMPTS AT IMPLEMENTING A COMMERCIAL MODEL IN LOW-INCOME MARKETS

Dong Thap Province, Vietnam

Floods hit the Mekong Delta every year, and Dong Thap is one of the most affected provinces, facing serious difficulties for children and their families. Many families’ homes have been inundated, forcing them to seek refuge in areas with poor sanitary conditions and without available clean drinking water. Dong Thap is far behind urban areas in terms of access to safe drinking water. Regular flooding added to atomization of communities living in villages, making it difficult to develop and implement piped-treated water systems.

Through the P&G pilot project, about 4,000 households in eight selected communities in the province participated in activities using PUR sachets for turbid water filtration. The communities were selected because they were representative of what could be implemented on a larger scale in Dong Thap Province: average villages of farmers, poorly educated, and most people using water taken directly from the river. In the first phase, P&G delivered about 227,000 PUR sachets for free. UNICEF was the key coordinator of this exploratory project. The objectives were to accomplish the following:

- \textbf{Introduce a simple and effective home water treatment in selected communities where public investments do not reach people effectively enough}
- \textbf{Increase awareness, commitment and action for using purifier of water sachets}
- \textbf{Look at how to generate a market to sell sachets at a profitable price}

The demonstration itself was divided into five steps:

1. \textit{Random tests of sachets to confirm the effectiveness of treatment.}
   - Tests were successful (see Appendix B)
   - PUR product is very efficient to purify water, as can be shown through the extensive testing made in several other parts of the world

2. \textit{Pilot field activities in the selected households and school classes.}
   - Guidelines for sachet usage translated into Vietnamese (the literacy rate is high in Vietnam- over 93 percent)
   - UNICEF, Vietnamese Ministry of Health and Centre for Rural Water Supply and Environmental Sanitation (CERWASS) trained families on sachet usage before any distribution

3. \textit{Skills-based education for water purification at village and community levels.}
• For instance, very few kindergartens and schools have facilities for hand washing with soap and safe disposal systems for waste. What facilities that do exist are often not designed for small children and are underused.
• Provincial and District Department of Preventive Medicine provided training on hygiene promotion for motivators, i.e. community leaders (teachers, doctors or elected representatives).

4. **Capacity building at village/community/district levels.**

• Former experimentations, in Africa suggest that water treatment is more of an individual and household issue not regularly discussed at the community level. The success threshold is therefore to scale-up discussion of water treatment from individual and household communications to the community level and higher, in the process creating a social norm around which behaviours and water treatment issues are openly discussed and fostering an enabling environment whereby minority ‘innovators’ who practice safe water consumption can transmit the behaviour through communication, example, and testimony.\(^9\)

• UNICEF developed training tools for community leaders to be ready for their roles to motivate households to use the PUR sachets. Consequently, community motivators implemented “awareness raising activities” in communities, to raise discussions and exchanges with people about sanitation and hygiene in general and how PUR sachets can help improve household treatment.

5. **Supervisory support to monitor how the sachets are used by collecting data weekly.**

• The US Centers for Disease Control and Prevention (CDC) helped UNICEF define monitoring tools and design implementation of a water safety plan model and hygiene promotion communication kits.

**Safe Drinking Water Alliance, Pakistan**

The Safe Drinking Water Alliance\(^10\) originated as a full commercial distribution model in Pakistan, where up to three million water-borne infections and one million deaths occur each year. In the first phase of the commercial model roll-out plan P&G employed 1,400 Educators to demonstrate the PUR technology in and around Karachi, with a population of approximately 15 million. Simultaneously, the USAID-funded Safe Water Council (implemented by Johns Hopkins CCP) conducted local, regional and national outreach to educate the public on the benefits of safe water and the range of technologies available to treat water. The hope was that the Safe Water Council’s generic “market priming” combined with direct product outreach through P&G might achieve enough synergy to catalyze what was thought to be a nascent market ready to mature. P&G’s commercial distribution of PUR

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\(^9\) Source: USAID

\(^10\) The Safe Drinking Water Alliance is a public-private initiative launched in 2004 by several partners (including P&G, USAID, PSI, CARE and Johns Hopkins Center for Communication Programs) to increase access to safe drinking water by low-income people in developing countries.
in Pakistan was successful in reaching more than 50,000 households who later became regular users of PUR.

LESSONS LEARNED FROM P&G’S EXPERIENCE
From its market studies and different experiences in commercializing PUR in low-income countries, P&G learned the following:

Pricing
The exploratory study by Ho Chi Minh Institute of Hygiene and Public Health in Vietnam supported P&G’s experience in other regions. The study found that people who are using the PUR sachets would like to have more supply for their use in both flood and dry seasons, because many of them use water directly from rivers and this is their only water source. In addition, people are becoming aware of the reasons why water purification is necessary, especially for their children, and they are willing to pay for it at a reasonable price. Sachets are thus given for free to affected people of flooding during humanitarian relief campaigns and can be found at an affordable price during dry seasons. For populations not affected by flooding, the product is for sale in shops and bazaars at low costs, i.e. less than a dime.

Advertising
P&G realized that before any mass marketing campaigns, local connections in the districts to commit nurses, doctors and community leaders was a key component to success, because people listen to their local healthcare providers and leaders. Local organizations leading projects explaining sanitation and how to use PUR during school programs can be an efficient leverage, as children’s education can become a Trojan Horse to encourage families to talk about water purification and hygiene at home. Some radio advertising can also be an efficient tool in the marketing campaign.

Packaging
A limit in the PUR product itself is its sachet distribution. Sachets were designed to be a good barrier to moisture and to have a long shelf life, and using PUR means much less use of firewood for boiling water. However, disposable sachets create many garbage items after use and can have a significant negative environmental impact. The sachets burn readily though, and that offers an option in most of the places where people are using PUR sachets. There are many examples of good practices, but they have not yet spread widely. A recyclable or reusable sachets packaging would reduce ecological footprint of PUR products.¹¹

Partnering
One key lesson was that point-of-use drinking water solutions using a market-based approach require broad collaborations involving the private sector, governments, NGOs and research institutions in order to provide effective education, marketing and product distribution. As Sally Cowal points out, regarding PSI’s alliance with P&G, “We’re learning a lot from one

¹¹ Using PUR means much less use of firewood for boiling water. The overall environmental impact is to be carefully studied.
another. They don’t know particularly well how to reach the bottom of the pyramid in the countries we work in; that’s what we know really well. But they know things about brands and brand management and sophisticated marketing and sales techniques that we [can] learn from them.”

Changing habits
Based on lessons learned in Africa, behaviour change outreach efforts suggest that consumer behaviour, with respect to the PUR product, is highly income elastic. If a consumer assigns an income amount for purchase of the product that does not meet the recommended sale quantity or frequency, the consumer will purchase as much of the product as his assigned income will allow. Thus, consumers may respond to messaging urging daily treatment of water but only purchase the product for use on a weekly basis. P&G realized that a one-time educational program does not bring about widespread regular use of any of the point-of-use interventions.

“In reaching down to the base of the pyramid, what we learned is that consumer habit change and awareness raising efforts are essential to creating market demand,” Dr. Greg Allgood, Associate Director for Corporate Sustainable Development at P&G, said. “They are also very expensive to conduct and essentially what we would be doing is public health education. Raising the awareness of the need to treat water – in the case of PUR – those all require significant consumer habit change, and in many respects that is the work of the public sector.”

Tests indicated that failure to trigger sustained behaviour change with respect to the new technology resulted in an insufficient re-purchase rate necessary to sustain a functioning market. Need for safe water is tied to episodic outbreaks of water-borne disease. Once the outbreak subsides, perception of the need to treat water at point-of-use also subsides. After three years of market tests in Guatemala, Morocco, Vietnam and Pakistan, the product had not made a profit. As Dr. Allgood explains, “We just couldn’t sell it fast enough to make a positive return.” It was a potent lesson for P&G.

A Reverse Strategy

A NON-PROFIT MODEL DESIGNED FOR DEVELOPING COUNTRIES
In 2005, P&G officially announced its new non-commercial approach and its decision to sell PUR at US$0.04 per sachet, the cost of production. The new non-profit strategy proved a success and by the end of 2006, P&G had sold 57 million sachets, at cost, to humanitarian organizations, in contrast to the mere three million sachets sold during the commercial phase. This ongoing commitment ensures P&G a strong internal and public reputation. It is based on a twofold model:
Social model

The social model involves the use of established social marketing distribution channels by non-profit organizations as well as a social network approach with local NGOs and Ministries of Health. In some countries, a social model is more appropriate due to economic and infrastructure constraints. This model is being used effectively in many parts of the developing world to provide important health products. Under P&G’s philanthropic Children’s Safe Drinking Water Program, implemented by its non-profit partner PSI, the PUR product is being distributed to multiple countries worldwide, including Asia (Iran, Bangladesh, Pakistan, and potentially Vietnam), Africa (Chad, Botswana, Morocco, Uganda, Kenya, Liberia, Malawi, Zimbabwe) and Latin America (Guatemala, Haiti).

In Haiti, a communications campaign has been launched together with the PUR product. For PSI this campaign marked the first time the organization socially marketed a brand originating from a for-profit partner. For P&G, it was a rare occasion where the firm allowed a third party to be responsible for having ownership of marketing one of its brands. For this social market, P&G received funding from USAID and DFID, allowing the social marketing model to graduate from operational research to program sustainability within five years.

The social marketing model has proven innovative and is now considered a promising approach to cultivate markets at the base of the pyramid.

Emergency model

The emergency relief model aims to address the lack of drinking water due to natural disasters (floods, earthquakes) or armed conflicts (resulting in internally displaced people or refugee situations). It involves product distribution along with education materials, typically provided by a relief agency. P&G has worked with many partners in response to natural disasters, including AmeriCares, Samaritan’s Purse, International Rescue Committee, UNICEF, Save the Children and the Red Cross. In Ethiopia, P&G is investigating a new programme with CARE in which a dried biscuit product pioneered by CARE is packaged with the PUR product to ensure the nutrition biscuit is not contaminated by the water used to prepare it. P&G also redirected 15 million sachets of PUR from its factory in Pakistan for tsunami relief. P&G has even partnered directly with communities in the United States seeking to participate in foreign aid. For instance, a Methodist Church raised over US$10,000 for victims of the Haiti mudslides and used the proceeds to purchase the PUR product at cost for humanitarian relief.

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12 Population Services International
13 From a business standpoint, social marketing is only one method of third party brand distribution. Other franchising distribution models exist that are not social marketing.
A BOTTOM-UP STRATEGY: MARKETING PUR FOR PROFIT IN HIGH-INCOME MARKETS

P&G realized that the single-use packets would be ideal for camping trips, other outdoor recreational uses or to sell to US tourists traveling to destinations where they cannot drink the water. Since July 2007, the PUR product is being sold in the United States through Reliance stores, for a retail price of US$2.50. PUR will be available through cardboard boxes containing six sachets, along with a filtering cloth, for US$14.99 or cartons of 240 sachets for US$64. Both companies expect the product to sell through stores that cater to campers and homeowners, especially those in hurricane-prone areas. P&G will funnel its share of profits back into its Children’s Safe Drinking Water Program.

Table 1: PUR Key Milestones Dates

<table>
<thead>
<tr>
<th>Date</th>
<th>Key Milestones</th>
</tr>
</thead>
<tbody>
<tr>
<td>1991</td>
<td>P&amp;G develops a chlorine bleach water-purifying product</td>
</tr>
<tr>
<td>1999</td>
<td>P&amp;G tests low-cost water filters in Guatemala and moves from filter purifiers to water treatment strategies</td>
</tr>
<tr>
<td>2000</td>
<td>P&amp;G launches powder product, PUR, priced at US$0.10 per sachet</td>
</tr>
<tr>
<td>2003</td>
<td>P&amp;G transfers PUR to the CSD unit as a non-profit venture</td>
</tr>
<tr>
<td>2004</td>
<td>P&amp;G donates its stockpile of sachets to PSI and delivers 15 million sachets to tsunami relief organizations</td>
</tr>
<tr>
<td>2005</td>
<td>P&amp;G makes PUR a “corporate signature product” and commits to selling it at cost indefinitely</td>
</tr>
<tr>
<td>2006</td>
<td>PUR reaches ten social markets and non-profit distribution totals 54 million sachets</td>
</tr>
<tr>
<td>2007</td>
<td>P&amp;G markets PUR for profit in high-income markets</td>
</tr>
</tbody>
</table>

Development Impacts

IMPROVING HEALTH

People in the experimental communities are heavily reliant on rice farming, agriculture and forestry for their livelihoods. They mustn’t be sick, because they have to go to work to make money, nor can they afford to travel too often to visit a doctor for a sick child. Using PUR sachets is helping reduce diseases due to pathogenic bacteria, viruses and parasites, especially with regards to children. Using the sachets also helps in reducing household exposure to arsenic-contaminated water. This results in higher productivity among workers and better school attendance among children. This light solution is also an effective local substitute to nationwide public investments in sanitations that have not been successful enough in reaching highly inhabited poor rural areas. Consequently, PUR helps reduce disparities between rural and urban areas, different regions and between the poor and the rich. Between 2000 and 2005, P&G provided 260 million litres of safe, clean water worldwide.
In 2005, PUR was rewarded the Stockholm Industry Water Award by the Stockholm International Water Institute (SIWI).

RAISING AWARENESS
Raising awareness is one of the direct objectives of P&G activities in developing countries – together with creating safe drinking water solutions that save lives. On March 22, the United Nation’s World Water Day, P&G organizes activities in dozens of countries to raise awareness among employees and populations, through demonstrations of the PUR product, displays of informative posters (for instance on public transport) and broad sharing of its World Water Day video. Awareness raising activities include a PUR brand campaign in the US (“Buy PUR, Help Save Lives”) to enable more PUR donations.

BENEFITING LOCAL DISTRIBUTORS
Although PUR does not generate a profit for P&G, it does for the local distributors. Indeed, the PUR sachets are bought at US$0.04 per unit by PSI, which then sells them to local entrepreneurs for US$0.05. They, in turn, sell them to villagers, generally for less than a dime (US$0.10). As Dr. Allgood explains, “It’s affordable for poor people, our costs are covered, and since the local distributors do make money on it, they have an incentive to promote it.”

Conclusion
P&G’s efforts suggest that there remains much to learn about developing successful business models that address the needs of low-income markets. Even though the business model developed by P&G enables the company to recover its costs, the barriers faced in this challenging environment have until now prevented it from becoming a sustainable profit-making activity, except for the local entrepreneurs who distribute the PUR sachets. However, this project provides an interesting and inspiring example of how an innovation designed to address low-income markets can be used to target high-income markets, while still doing its part to help developing countries achieve the MDGs.
References


Hanson, M. 2007. “Procter & Gamble’s partnership with non-profit organizations is proof that local markets can be won over new products.” World Business Live. 1 April 2007.


**Interviews**

Interviews with stakeholders, including PG Headquarter, PG Vietnam, and UNICEF conducted in October and November 2006.
## Appendix A: Instructions to use PUR

### PUR Purifier of water

**Objective:** To demonstrate the benefit of using PUR.

**Materials:**
- 1L of water
- 1 PUR purifier

**Procedure:**
1. Turn on the water tap to fill the 1L container with water.
2. Place the PUR purifier over the container.
3. Wait for 3 minutes for the water to filter through.
4. Measure the amount of water remaining.

**Results:**
- The water is clearer and has less impurities.

### PUR Purificador de agua

**Objetivo:** Demostrar el beneficio del uso de PUR.

**Materiales:**
- 1L de agua
- 1 PUR purificador

**Procedimiento:**
1. Abre el grifo para llenar el contenedor de 1L de agua.
2. Coloca el purificador de agua en el contenedor.
3. Espérate 3 minutos para que el agua pase por el purificador.
4. Medir la cantidad de agua restante.

**Resultados:**
- El agua es más clara y tiene menos impurezas.

### PUR Purification of water

**Object:** To demonstrate the product.

**Materials:**
- 1L of water
- 1 PUR purifier

**Procedure:**
1. Open the faucet to fill the 1L container with water.
2. Place the PUR purifier over the container.
3. Wait for 3 minutes for the water to filter through.
4. Measure the amount of water remaining.

**Results:**
- The water is clearer and has less impurities.

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**Source Water**

- FeSO_{4} \cdot 7H_{2}O: 350 mg/L Fe^{2+}
- CaCl_{2}: 300 mg/L Ca^{2+}

**After PUR Addition**

- FeSO_{4} \cdot 7H_{2}O: 35 mg/L Fe^{2+}
- CaCl_{2}: 20 mg/L Ca^{2+}

**After Complete Stirling**

- FeSO_{4} \cdot 7H_{2}O: 10 mg/L Fe^{2+}
- CaCl_{2}: 5 mg/L Ca^{2+}

**Through a Clean Cotton Cloth Filter**

- FeSO_{4} \cdot 7H_{2}O: 2 mg/L Fe^{2+}
- CaCl_{2}: 1 mg/L Ca^{2+}

**Ready for Storage and Use**

- FeSO_{4} \cdot 7H_{2}O: 1 mg/L Fe^{2+}
- CaCl_{2}: 0.5 mg/L Ca^{2+}
Annex B: Laboratory and Field Testing of PUR

### Effective in Removing Viruses

<table>
<thead>
<tr>
<th>Virus</th>
<th>Initial Viral Count/ml (log 10)</th>
<th>Mean Log Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poliovirus</td>
<td>7.1</td>
<td>&gt;5.0</td>
</tr>
<tr>
<td>Rotavirus</td>
<td>7.9</td>
<td>&gt;5.0</td>
</tr>
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</table>

### Effective in Removing Cysts

<table>
<thead>
<tr>
<th>Cyst</th>
<th>Mean Initial (org/liter)</th>
<th>Mean Log Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cryptosporidium parvum</td>
<td>1.76 x 10^5</td>
<td>4.0</td>
</tr>
<tr>
<td>Giardia lamblia</td>
<td>1.84 x 10^5</td>
<td>3.6</td>
</tr>
</tbody>
</table>

### Reduction of Heavy Metals

<table>
<thead>
<tr>
<th>Heavy Metal</th>
<th>Initial (ppb)</th>
<th>Post-Treatment (ppb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arsenic</td>
<td>229</td>
<td>1.2*</td>
</tr>
<tr>
<td>Chromium (III)</td>
<td>1300</td>
<td>3.1*</td>
</tr>
<tr>
<td>Lead</td>
<td>270</td>
<td>&lt;10*</td>
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</tbody>
</table>

* Below WHO Guideline

### Remover Organics and Some Pesticides

<table>
<thead>
<tr>
<th>Test Material</th>
<th>Initial (ppm)</th>
<th>Post-Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Humic acid</td>
<td>24-30</td>
<td>&lt;1</td>
</tr>
<tr>
<td>DDT (ppb)</td>
<td>6</td>
<td>0.34</td>
</tr>
</tbody>
</table>

WHO Guideline for DDT = 2 ppb