FINAL DEGREE PROJECT

BIVALVE. HUMANITARIAN PROJECT

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I would like to acknowledge the support of NGOs like Creu Roja Catalunya and Acción Contra el Hambre amongst others who gave me a lot of information to identify the main problem and it allowed me to realize an exhaustive ethnographic study. I am also grateful to my tutor Sergi Bueno who encouraged me to pursue this topic and spent extra time helping me to achieve a clear structure. Finally I would like to acknowledge the support of my father in the entire project process.
INTRODUCTION

Sometimes our community or ourselves, we have some problems that can be really different or important. Actually, these problems usually can be hard for some families and people: banks expropriating houses, people without job and money, precarious employments… so, many examples could be more or less shocking. Otherwise, if tomorrow a typhoon comes to Catalunya and havoc everything, we have some organizations (Government, UE, NGO…) that have sources for take care this disaster can be lower, although we live in a country where thanks to its geography is strange that it never happen. But, there are some places in the world where every year a typhoon come, moreover they do not have good sources and they need help of the rest of the world. So, sometimes I think that I am lucky to born in my country because we cannot choose it; if we can, we should help the others as far as we can.

For that reason, this research project is created to solve a problem focused in countries where they do not have purifier water (a direct issue) because it is really difficult get it in these situations.

TARGET

Bivalve becomes from Humanitarian help concept. In this project the main target was create something to make easy the situation which Filipinos are suffering.

So, as one of the main problems was lack water, everything related in transport, easy operation, low cost were a target to carry on this project. Must be said that an specific condition to realize Bivalve was create something different to the competece and can transport more purifiers on the same form of transport.
ANALYSIS OF THE PROBLEM
This project started with the concept of “Humanitarian Help”. However, it is too much open, for that this term it is done a mind map.

Chosen branch is Food. It can realize a focused mind map where came out two other fields: water and cooking. These two concepts will be unified to carry out a new product.

The concepts extracts from this localized mind map are water, purification and transport.
From August to December in Philippines there is the Pacific typhoon season. Last November typhoon Haiyan arrived in there.

Typhoon Haiyan was one of the strongest tropical cyclones recorded, which devastated portions of Southeast Asia. Haiyan attained ten-minute sustained winds of 330 km/h.

The winds and rains destroyed everything, houses, fields and killed many people.

After this disaster Philippines’s people lost their most important sources. They needed aid like food, water, shelter...

NGO’s arrived there and helped people, providing all they needed. Governments and citizens of other countries sent money to rebuild the country.

Nowadays they need more help of everyone.
INVESTIGATION METHODS

INTERVIEWS
USER’S NEEDS STUDY
ETNOGRAPHIC STUDY

REFERENT ANALYSIS
PRECEDENT ANALYSIS
STUDIES CONCLUSIONS
BRIEFING
The problem to be solved is related to water purifying. For analyze this problem, the methods used has been interviews, documents provided by NGO's and videos to counteract all information founded.

First of all some questions have been redacted to organize what is important to know:
- About organization.
- What is the humanitarian help?
- How they manage humanitarian help.
- How to receive proper receipt of the aid sent.
- Is someone in the country who organization can contact to distribute everything?

NGO's asked are: Red Cross, Acción Contra el Hambre, Save the Children, Inte-
red, Plan España, Marie Undice, Caritas, Abra and Interner Oxfam. They are the
most NGOs implied in help Philippines after Haiyan Typhoon.

Red Cross conceded an interview, some others NGOs sent only information althou-
gh not all, just Acción Contra el Hambre, InteRed and Caritas.

The person interviewed was Ramon Jané, Occupation and International Coopera-
tion Director in Red Cross Catalunya. He explained which is their task in countries
where suffered natural catastrophes.

**ABSTRACT OF RAMON JANE’S INTERVIEW. Occupation and International Cooperation Director**

Red Cross is a solidarity organization its main function is helps countries which
have suffered natural disasters. All the material which is send to these countries is
stored in different places in Spain; from there, all the humanity help is distributed
by plane, train...

Before to go to the country of the disaster, the organization has evaluated and
diagnosed needs and resources. Then if the country needs help, an international
call is set in motion, so is the local Red Cross who asks help to the Red Cross Inter-
national Federation which coordinates the distribution, it carries out by Red Cross
from all over the world. First days, the aid only can be things that local people need
(shelter, sanitary material, for purify water, some food...), some days after Red
Cross sends hygienic and cooking kits, blankets and structures. Everything has to
consider transport and logistics (everything in boxes and to be easy to transport).

In Red Cross there is a sub-organization called ERU (Emergency Response Unit)
which is formed for specialized people in each emergency. There are 7 units; it
depends on the emergency psychological support, aid, massive sanitation, logis-
tics and telecommunication. There is also some local people who makes apaches
for awareness and sensibilized the local population. When the help arrives on the
place, the local Red Cross is responsible to store and distribute everything. All the
units are important to not duplicate efforts and it is also important preserve local
culture regarding food.

Following the genocide in Rwanda NGOs came together to draft the sphere which
is to improve the quality and accountability in humanitarian aid.

I took in contact with Julien Jacob of Acción Contra el Hambre, he sent some infor-
mation like Philippines lifestyle, what kind and quantity of aid they send and some
links of web pages to know more information.

InteRed sent two videos which explained what happen after Haiyan Typhoon and
how they act in view of this disaster.

Caritas also sent some documents where explained their action in Philippines.

Thanks to this information do ethnographic study and user needs have been easier.
Some information has been confirmed and some other has been useful because it
is difficult to get it. So, it has proved in many families who their lives on devastated
and remote town is difficult provide clean water. It is caused for a difficult logistic
and transport in that areas.
The main source of income is agriculture and fishery. So, when a typhoon like Haiyan (one of the most devastating) arrives in the Philippines, families lose everything (fields, houses, food, water... and the worst thing: lives).

This is a war against weather and they need help of everybody. First days, the aid only can be staff that local people need (shelter, sanitary material, for purify water, some food...), some days after Red Cross and other NGO’s send hygienic and cooking kits, blankets and structures. Everything has to consider transport and logistics (everything in boxes or packed to be easy to transport).

For recuperate their source of income, NGO’s also supply agricultural input kits, material to rebuild boats and money.

According to “Acción contra el hambre”, NGO’s provide this kind of food (for 5 pp household for two weeks):

<table>
<thead>
<tr>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good quality rice</td>
<td>25 kilos</td>
</tr>
<tr>
<td>Saltines</td>
<td>1 pack</td>
</tr>
<tr>
<td>Iodized Salt (0.15 kg)</td>
<td>1 pack</td>
</tr>
<tr>
<td>Beef or Chicken Noodles</td>
<td>96 packs</td>
</tr>
<tr>
<td>Cooking Oil (1 litre)</td>
<td>1 bottle</td>
</tr>
<tr>
<td>Sugar (1.5 kg)</td>
<td>1 pack</td>
</tr>
<tr>
<td>Green Mungbeans</td>
<td>1 kilo</td>
</tr>
</tbody>
</table>

NGO’s also provide Non-Food Items that this kit includes: plastic mat (1 piece), blanket (1 piece), mosquito net (1 piece), flashlight with battery (1 piece), cooking pot (1 piece) and a packing bag.

Residents cover their nose from the smell of dead bodies in Tacloban city, Leyte province central Philippines.

People take shelter in a parish church in the Philippines.

They also provide some biscuits that can be eaten dry and they have energy but they can be culturally unfamiliar and more expensive.
Water and food are the most important elements because people can survive; currently this is the main problem in Philippines. For this reason, this project will be destined to deal one of these fields, water. Concretely in remote regions where is difficult access to provide water and other kind of aid, either caused by fallen trees on the way or bad weather, that is a big problem for transport (lorries, vans...).

The timing of aid distribution can be 72 h - 2 weeks - 8 weeks, depending on type of aid, has to keep in mind:
- Supply sources
- Border crossing
- Storage needs
- Availability facilities management
- Low cost

In Philippines there are many towns in this situation and people who suffers this problem a lot, for this reason the focus user is group of people who live together.
ETNOGRAPHIC STUDY

As it has been explained, from August to December in Philippines there is the Pacific typhoon season. This is a real problem for the people who live there, because their everyday life changes completely. In that season their most important thing is survive.

For purify water a significant work remains to repair the network mains and to improve pressure and reduce network leaks. Many studies claim that in Philippines the risk of major infectious diseases is high; the most usually diseases in food or waterborne are bacterial diarrhoea, hepatitis A and typhoid fever. There are also vectorborne diseases like dengue fever and malaria and water contact diseases like leptospirosis.

Distributions of household water purification stocks will need to continue until safe supplies are re-established. Portable field level water testing kits and facilties are badly needed to monitor the water quality. NGO’s provide jerry cans & hypochlorite or they use water bladders.

People filling water bladders of purified water of that lorry Jerry cans with hypochlorite
**BIVALVE, HUMANITARIAN PROJECT. upc-epsevg**

**REFERENS ANALYSIS**

First of all, different kind of methods to purify water are analyzed. To this form, the best system can be chosen.

<table>
<thead>
<tr>
<th>System</th>
<th>Description</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boiling</td>
<td>Boiling water kill bacteria as well as other disease-causing microorganisms like <strong>Salmonella</strong> and <strong>Cryptosporidium</strong> which are commonly found in towns and lakes. Water temperatures above 70 °C (158 °F) will kill all pathogens within 30 minutes, above 85 °C (185 °F) within a few minutes, and boiling point (100 °C (212 °F))</td>
<td>Increase duration of boiling required to kill certain pathogens. Most pathogens will be killed, excluding certain pathogens and their spores, which must be heated to 118 °C (249 °F) to ensure complete sterilization. Boiling cannot remove chemicals having boiling points at or above 100 °C (212 °F), nor heavy metal contamination, e.g., colloid metal pollutants.</td>
<td></td>
</tr>
</tbody>
</table>

| Filtration | Portable pump filters are commercially available with various filters that filter 5,000 to 50,000 litres per cartridge, removing pathogens down to the 0.2–0.3 micrometer (µm) range. Some also utilize activated charcoal filtering | Most filters of this kind remove most bacteria and protozoa, such as Cryptosporidium and Giardia lamblia. It is worth noting that not all bacteria are removed by 0.2 µm pump filters. | 

| Activated carbon adsorption | Activated carbon can remove chlorine from treated water, removing any residual protection remaining in the water protecting against pathogens. Ceramic/Carbon Core filters with a 0.5 µm or smaller pore size are excellent for removing bacteria and cysts but also removing chemicals. | Activated carbon filters aren’t usually used as the primary purification technique of portable water purification systems. It is a complement of a purification technique. | 

| Chemical disinfection | Iodine used for water purification is commonly added to water as a solution, in crystallized form, or in tablets containing tetracycline hydrochloride that release 8 mg of iodine per tablet adaptation to chronic tetracycline hydrochloride. Iodine is available in camping stores that include an iodine pill and a second pill (vitamin C or ascorbic acid) that will remove the iodine taste from the water after it has been disinfected. The time for purify water is 30 minutes if it is warm but could be longer if it is cold or rusted. | The iodine kills many but not all of the most common pathogens present in natural fresh water sources. Iodine treated drinking water treated with tablets containing tetracycline hydrochloride, also reduces the uptake of radioactive iodine in humans subjects to only 2% of the value it would otherwise be. Some manufacturers suggest not using the tablets more than three months after the container has initially been opened, the shelf life is in fact very long provided the bottle is resealed immediately after each time it is opened. | 

**BIVALVE, HUMANITARIAN PROJECT. upc-epsevg**
<table>
<thead>
<tr>
<th>System / Water Treatment Method</th>
<th>Description</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ultraviolet purification</td>
<td>Ultraviolet (UV) light induces the formation of covalent linkages on DNA and thereby prevents microbes from reproducing. Without reproduction, the microbes become far less dangerous.</td>
<td><strong>A concern with UV portable water purification is that some pathogens are hundreds of times less sensitive to UV light than others.</strong> Water treated with UV still has the microbes present in the water, only with their means for reproduction turned “off”. In the event that such UV-treated water containing neutered microbes is exposed to visible light (specifically, wavelengths of light over 330-500 nm) for any significant period of time, a process known as photo reactivation can take place, where the possibility for repairing the damage in the bacteria’s reproduction DNA arises, potentially rendering them once more capable of reproducing and causing disease.</td>
<td></td>
</tr>
<tr>
<td>Solar water disinfection (SODIS)</td>
<td>In solar water disinfection (SODIS), microbes are destroyed by temperature and UVA radiation provided by the sun. Water is placed in a transparent plastic PET bottle, which is first oxygenated by shaking partially filled capped bottles prior to filling the bottles all the way. The completely water-filled and capped bottles are exposed to sunlight, preferably on a corrugated metal roof, slanted slightly to maximize the exposure to solar radiation (6 hours or two days depending on weather).</td>
<td>The combination of the two effects (UVA and heat) provides a simple method of disinfection for use in tropical developing countries, or in survival situations. The use of glass bottles may or may not provide the same degree of SODIS disinfection as using PET bottles. For cases where the UVA is blocked, or reduced, only the heating effects without adequate UV exposure are typically at work if glass bottles are used, potentially leaving dangerous amounts of bacterial and viral loads within the water.</td>
<td>The use of glass bottles may or may not provide the same degree of SODIS disinfection as using PET bottles. For cases where the UVA is blocked, or reduced, only the heating effects without adequate UV exposure are typically at work if glass bottles are used, potentially leaving dangerous amounts of bacterial and viral loads within the water. The use of glass bottles may or may not provide the same degree of SODIS disinfection as using PET bottles. For cases where the UVA is blocked, or reduced, only the heating effects without adequate UV exposure are typically at work if glass bottles are used, potentially leaving dangerous amounts of bacterial and viral loads within the water.</td>
</tr>
<tr>
<td>Solar distillation</td>
<td>The solar still relies on sunlight to warm and evaporate the water to be purified. The water vapour condenses, usually on a plastic sheet suspended as an inverted cone, dripping into a collection cup placed beneath it. For more continuous use, thin tubing or a hose is sometimes routed into the collection cup placed beneath it. For more continuous use, thin tubing or a hose is sometimes routed into the collection cup placed beneath it.</td>
<td>The reliability of such systems is highly variable. Such filters can do little, if anything, to mitigate germs and other harmful constituents and can give a false sense of security that the water so produced is potable. Water processed through improvised filters should be undergoing secondary processing such as boiling to render it safe for consumption.</td>
<td></td>
</tr>
<tr>
<td>Homemade water filters</td>
<td>Water filters can be made on-site using local materials such as grass, charcoal (e.g. from likewise burned in a special way).</td>
<td>Low cost</td>
<td></td>
</tr>
</tbody>
</table>

Once all the systems studied, for design the product, a combination between filter and activated charcoal will be chosen. This is a good one because its lifecycle is long and you should not do anything during the process. Moreover, the focus problem is in Philippines and this system is also good aware of the weather.
Portable Aqua Unit for Lifesaving (PAUL)

Operation
The core of the device is a membrane filter unit. After it is set up at its destination, it is filled with about 100 litres of raw water from surface waters. After a waiting period of one to two minutes the filtered water flows out of the drain hose. During filtering raw water must be replenished continuously.

Performance
At about 1.15 meters of water pressure, the water is filtered through the membrane with a pore size of 20 to 100 nm. The device removes bacteria and viruses with an efficiency of 99.999 %. It is based on ultrafiltration system, are not able to filter out solutes like salts or liquids like mineral oils. They pass through the membrane. Water contaminated with such substances therefore cannot be cleaned.

A device with an average amount of 1200 litres of water is able to filter per day for 400 people with the Sphere standards (2011) and to supply the necessary drinking water.

Livesaver bottle

Operation
To filter the water, one puts contaminated water in the back of the bottle, then screws the lid on. The lid has a built in pump which is operated manually with a hand; the pumping action forces the contaminated water through the nano-filter and safe drinking water collects in another chamber in the bottle. The drinker then opens the top of the bottle from which safe drinking water comes out.

Performance
The bottle’s interchangeable filter can purify between 4,000 and 6,000 litres (1,050 to 1,585 gallons). It filters out objects bigger than 15 nanometres—including viruses, bacteria, and heavy metals. The carbon filter does not require chemicals. The process of filtering the water takes 20 seconds, allowing for 0.71 litres (1.5 pints) of water to be filtered. Once a filter has reached its limit, it will not allow contaminated water to be drunk.

Live saver has a great range of products to purify water.
Lifestraw / Lifestraw family

Operation

The Lifestraw is a plastic tube 310 mm long and 30 mm in diameter. Water that is drawn up through the straw first passes through hollow fibres that filter water particles down to 0.2 µm across, using only physical filtration methods and no chemicals. The entire process is powered by suction, similar to using a conventional drinking straw.

Performance

Lifestraw removes a minimum of 99.9% of waterborne protozoan parasites including *Giardia* and *cryptosporidium*. It filters up to 1000 litres, but there is also Lifestraw family which filters a maximum of 18,000 litres of water, providing safe drinking water for a family of five for up to three years, and there is also Lifestraw Go.

Tata Swatch

Operation

The purifier consists of two parts: an upper reservoir where the untreated water enters and a lower middle portion with a bulb to which the cartridge can be attached. Another reservoir is placed at the lower end, which collects purified water. The two chambers are stackable and arranged so that the entire system can function on gravity.

Performance

In the Tata Swach design, water purification is carried out using processed rice husk ash impregnated with nano (1 x 10⁻⁹) silver particles for purifying the water and to destroy disease-causing bacteria, germs, and other organisms. The bacteriostatic and bactericidal properties of silver are attributed to its ability to react with the sulfhydryl (-SH) groups in the bacterial cells that produces the structural changes in bacterial cell membranes and interacts with nucleic acids. The nano sized particles help in increasing the surface area so that the bacteria get enough reaction time.

Swach can purify water at the rate of about 3 to 4 litres every hour. There are also Tata Swach Smart and Smart Magic variants with a more compact design, holding 15 and 7 litres respectively. There are other types of water purifiers of Tata:
**Summary Table**

<table>
<thead>
<tr>
<th>Description</th>
<th>Capacity</th>
<th>Time to filter</th>
<th>% purification</th>
<th>Duration</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bivalve, Humanitarian Project.</strong> upc-epsevg</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The core of the device is a membrane filter unit. After it is set up at its destination, it is filled with about 100 litres of raw water from surface waters. After a waiting period of one to two minutes the filtered water flows out of the drain hose. During filtering raw water must be replenished continuously.</td>
<td>100 l</td>
<td>1 – 2 minutes</td>
<td>99.99 %</td>
<td>10 years</td>
<td>1200€</td>
</tr>
<tr>
<td>To filter the water, one puts contaminated water in the back of the bottle, then screws the lid on. The lid has a built in pump which is operated manually with a handle; the pumping action forces the contaminated water through the nano-filter and safe drinking water collects in another chamber in the bottle. The drinker then opens the top of the bottle from which safe drinking water comes out.</td>
<td>0.750 l</td>
<td>20 seconds</td>
<td>99.999%</td>
<td></td>
<td>120€</td>
</tr>
<tr>
<td>If you are going travelling or taking the family camping you can receive the same level a good protection. Perfect for the boot of the car, this unit is so efficient it even comes with a shower attachment so you can wash with clean water. Able to hold up to 18.5 litres at any one time, it is a simple solution for your home or leisure activities where you are going to need instant access to safe water for eating, drinking, washing and cooking.</td>
<td>18.5 l</td>
<td>20 seconds</td>
<td>99.999%</td>
<td></td>
<td>202.42€</td>
</tr>
</tbody>
</table>

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<tr>
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<tr>
<td><strong>Bivalve, Humanitarian Project.</strong> upc-epsevg</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The LifeStraw is a plastic tube 310 mm long and 30 mm in diameter. Water that is drawn up through the straw first passes through hollow fibres that filter water particles down to 0.2 µm across, using only physical filtration methods and no chemicals. The entire process is powered by suction, similar to using a conventional drinking straw.</td>
<td>0.220 l</td>
<td>-</td>
<td>99.99 %</td>
<td></td>
<td>25€</td>
</tr>
<tr>
<td>LifeStraw® Family is a large volume water filter which provides up to 16,000 litres of water, enough to supply a family of five with clean drinking water for up to three years.</td>
<td>2 l</td>
<td>9 – 12 l /h*</td>
<td>99.99 %</td>
<td>After 18,000 litres purified</td>
<td>100 €</td>
</tr>
<tr>
<td>LifeStraw Community® is a best practice water filtration system designed for the larger community and is especially effective for institutions such as hospitals and schools. In many parts of the world hospitals and schools children do not have access to fresh water for children are sometimes sent home from school if drinking water is not available.</td>
<td>25 l</td>
<td>9.9 lh</td>
<td>99.999%</td>
<td>After 100000 litres purified</td>
<td>-</td>
</tr>
</tbody>
</table>

* Water flow

**Notes:**
- All prices in Euros (€)
- * Water flow refers to the rate at which water can be filtered through the device.
The LIFESAVER® C2™ is a 750 litre water bowser containing the proven LIFESAVER® nano filtration technology. It is capable of delivering up to 2 million litres of safe, sterile drinking water from any water source*. The LIFESAVER® C2™ produces clean water at up to 18 litres per minute; ideal for schools, hospitals and humanitarian camps where traditional infrastructure is not possible.

**Capacity** | **Time to filter** | **% purification** | **Duration** | **Price**
--- | --- | --- | --- | ---
750 l | 18 l/min* | 99.999% | After 2 million litres | -

The purifier consists on two parts: an upper reservoir where the untreated water enters and a lower middle portion with a bulb to which the cartridge can be attached. Another reservoir is placed at the lower end, which collects purified water. The two chambers are stackable and arranged so that the entire system can function on gravity.

**Capacity** | **Time to filter** | **% purification** | **Duration** | **Price**
--- | --- | --- | --- | ---
14 l | 3-4 l/h* | - | After 3000 litres purified | 32€

Tata Swach Smart effectively destroys disease-causing water-borne bacteria and viruses and makes water safe for drinking. Uses Silver Nanotechnology to effectively remove harmful bacteria and viruses.

**Capacity** | **Time to filter** | **% purification** | **Duration** | **Price**
--- | --- | --- | --- | ---
14 l | 3-4 l/h* | - | After 3000 litres purified | 112€

The LIFESAVER® cube™ is the perfect family accessory allowing you to have access to instant sterile water for your home and leisure time. A simple to use portable device, requiring no installation and offering up to 5000 litres of water filtration, the LIFESAVER® cube™ is the latest product in the LIFESAVER® family.

**Capacity** | **Time to filter** | **% purification** | **Duration** | **Price**
--- | --- | --- | --- | ---
5 l | 20 seconds | 99.999% | After 5000 litres purified | 151,4€

Tata Swach Bulb is the main purifying unit of the product. The Swach Bulb, depending on the quality of water, can purify about 3000 litres of water, after which the bulb must be replaced. The bulb has a “Fuse” indicating when a cartridge change is required.

**Capacity** | **Time to filter** | **% purification** | **Duration** | **Price**
--- | --- | --- | --- | ---
- | - | - | After 1500 litres purified | 59€

LifeStraw® Go incorporates the award-winning LifeStraw® technology into a durable water bottle. Simply scoop water from a river or pond, screw the lid on, and sip clean water through the mouthpiece.

**Capacity** | **Time to filter** | **% purification** | **Duration** | **Price**
--- | --- | --- | --- | ---
0,67 l | - | 99.9% | After 1000 litres | 40 €
BRIEFING

Product: Water filter for countries which suffered natural catastrophes
Target: Design and solve a water filter specific for:
- Optimise logistics
- For places where terrain is not smooth

Features specifics of the project:

- Refer to the content
  - It has to be a volume according to 5 people because this is the average quantity of family
  - Should not use water pump to operate because it has to be simple
  - Should see the content
  - Its dimensions cannot be higher than back

- Refer to ease of use
  - Opening for extract water which do not have to apply much force
  - It has to be easy to transport regarding to shape
  - Opening of filter appropriate to introduce water
  - It has to be easy to take

Studies Conclusions

After entire studies, I can say that in conjunction with many NGO’s has been very important because they provided a lot of information and they explained either by documents or talking. Filipinos life and how NGO’s or governments help them. After that, when the focus problem has been detected I could do an exhaustive ethnographic study explaining how they live and what is their main economic source, what happen when they do not have potable water, how they survive and what kind of problems are they involve. Once this is done the analysis of referees has become a good tool to research competences and study their products: product operation, dimensions, target public... It has been a good help to decide what things are more important and what can get as reference.

With all this information I can do a good briefing to define how will be the product.

Referred to signalling
- Indication on the top of the opening if the bag is for clean or dirty water

General Features:
- General ergonomy
- Manipulation opening for right-handed and left-handed
- It has to be much economic as possible
- Indication to know when product life is over
BRIEFING PROPOSE AND DEVELOPMENT

CONCEPTS
ERGONOMIC AND
ANTHROPOMETRIC STUDY
USABILITY AND FUNCTIONAL STUDY

PROPOSAL DIMENSIONS
MATERIAL SELECTION
APPLIED TECHNOLOGY
INDUSTRIAL PROCESS
CONCEPTS

FIRST SKETCHES

- Pitcher
- Flagon
- Chylkett
- Juge (pouyge + rovillon)
BIVALVE, HUMANITARIAN PROJECT. UPC-EPSEVG

Final sketches

epoxi resin + stitched
opaque
filter
To realize the ergonomic study, first of all it has studied how Filipinos carry their staff, for example babies, sacks or the most important for this project, water and how they will use the product. Moreover not in all countries people have the same tall. In Philippines the average tall is for man 163.4 cm and for woman 151.7 cm.

These photographs are a good example and a good help to know how they carry something and in consequence which anthropometric measures are necessary.

*PHILIPPINE FACTS AND FIGURES 2003 – Part II. Anthropometric Facts and Figures*
In this part there are only two percentiles, it has chosen percentile 5 because is close to 10 (percentile chosen first). On the table above, you can see dimensions D and E that are interesting for the product. So, it is a unisex product, a maximum size will be the extremes. For example: dimension E can be 60,2 cm → 602 mm (maximum or recommended) and dimensions D can be 44,2 cm → 442 mm (maximum).

The main dimensions are I, J, K, L because they are essential for take the product by a handle. It has chosen percentile 5 for the same reason as the rest. So, the handle has to be minimum this dimension 200 mm (length) and 50 mm (=(I-J) will be 80 mm aprox. but 50 mm it is enough).

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
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<th>J</th>
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<th>L</th>
<th>M</th>
<th>N</th>
<th>O</th>
<th>P</th>
<th>Q</th>
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</table>

Dimensions of the product: handle and size of hands and men's wrists.

In the table above, you can see dimensions D and E that are interesting for the product. So, it is a unisex product, a maximum size will be the extremes. For example: dimension E can be 60,2 cm → 602 mm (maximum or recommended) and dimensions D can be 44,2 cm → 442 mm (maximum)
Open brown bottle stopper
Take water from the river or anywhere
Open the first bag in full sun direction on your back
Once the first bag is full, carry Bivalve on your back through ropes while the water is purified
Change ropes position or hang Bivalve correctly vertical for a good filtration
Open blue bottle stopper
Finally put a pot under Bivalve to keep clean water.
PROPOSAL DIMENSIONS

332

453

PROPOSAL DIMENSIONS

BIVALVE HUMANITARIAN PROJECT UPC - EPSEVG
MATERIAL SELECTION

To decide the bottle stopper material, think about what is the main use is very important. So, this stopper should be watertight but for open and close it should not apply too much force, it has to be suitable for everybody. Moreover it should have a long lifecycle and it has to be suitable on water, this is also important. Finally this material has to be economic. I can look for this material in CES Edu Pack and other sources.

Possible materials can be PA, SAN, PP, EPDM. Finally EPDM is chosen, concretely Santoprene because it combines durability and flexibility. It is an elastomer has the same properties found in natural rubber materials. However, it is regarded to be much better to use in this product because it lasts longer than rubber. Santoprene has also been found to be very resilient when subjected to extremely hot or cold temperatures. The material has also been seen to perform as well as EPDM (ethylene propylene diene monomer) when it comes to electrical properties and resistance against environmental aging. Just like EPDM, Santoprene is also highly liquid resistant. The material’s low production cost and its high quality are the top reasons why project managers are choosing Santoprene over other rubber materials.

There are many types of Santoprene, so the chosen is 271-55, this is a good one because it is designed for non fat food contact applications. It is soft, colourable and is completely recyclable.
For producing this bag, the material needed has to be malleable for roll itself and to this way can transport more quantity of Bivalve. Moreover this bag should be transparent to see dirty and clean water, resistant on weight, terrain... In fact, this product has to be sturdy and economic too.

Possible materials are K-Resin SBC, PVC, LDPE and PP because all of them are suitable as water recipient and they are more or less malleable.

Finally the material chosen is LDPE. It is defined by a density range of 0.910–0.940 g/cm³. It is not reactive at room temperatures, except by strong oxidizing agents, and some solvents cause swelling. It can withstand temperatures of 80 °C continuously and 95 °C for a short time. Made in translucent or opaque variations, it is quite flexible.

LDPE has more branching (on about 2% of the carbon atoms) than HDPE, so its intermolecular forces ( instantaneous-dipole induced-dipole attraction) are weaker, its tensile strength is lower, and its resilience is higher. Also, since its molecules are less tightly packed and less crystalline because of the side branches, its density is lower. LDPE contains the chemical elements carbon and hydrogen. In summary LDPE is semi-rigid, translucent, very though, weatherproof, good chemical resistance, low water absorption, easily processed by most methods and low cost.

To make the bottleneck, its material will be LDPE as well, although in this case it will be rigid.
To decide the best material to make the box is important to know what will be its use. This box has to container the filter, for this reason the material should be resistant and watertight. Moreover, it is advisable that this box be economic and adaptable to users.

Possible materials are PP, ABS, PA.

The material decided is PP, it does not present stress-cracking problems and offers excellent electrical and chemical resistance at higher temperatures. While the properties of PP are similar to those of Polyethylene, there are specific differences. These include a lower density, higher softening point (PP does not melt below 160 º C and Polyethylene 100 º C) and higher rigidity and hardness. Additives are applied to all commercially produced polypropylene resins to protect the polymer during processing and to enhance end-use performance.

The properties of Polypropylene are:
- Semirigid
- Translucent
- Good chemical resistance
- Tough
- Good fatigue resistance
- Good heat resistance

Three types of polypropylene are currently available. Each suits particular specifications and costing: Homopolymers, Block copolymers and Random copolymers. The material chosen is polypropylene Homopolymers because it is a general-purpose grade that can be used in a variety of different applications.
The system used in this project is an existing method; it is an activated carbon filter. As seen before, there are many products which use this system.

Fiber system:
The first is a textile pre-filter. The tiny openings in the mesh of this filter measure 100 microns in a diameter. A micron is a millionth of a meter, so 100 microns is a tenth of a millimeter. If you’re still trying to picture the actual size, look at a strand of hair. That is about 100 microns in a diameter. This filters out bigger particles, like dirt and sediment.

Next the water passes through a polyester filter. The holes in the mesh of this filter are much smaller—only 15 microns. Reportedly, this filters out clusters of bacteria.

From there, the water moves through a chamber of beads that are impregnated (saturated) with iodine. The iodine kills parasites and 99.9% of bacteria and viruses.

And finally, the water passes through a chamber of granulated active carbon. Not only does the carbon improve the taste and smell of the water, it should also filter out any remaining parasites.

**TECHNICAL SPECIFICATIONS**

- Minimum operating temperature: >0ºC (32ºF)
- Maximum operating temperature: <50ºC (122ºF)
- Bacteria retention: >99.999995% (log 7.5)
- Virus retention: >99.999% (log 5)
- Cartridge service rating: 5000l
- Water flow rate: according to level of water purified
- Initial flow rate: 0.75L/min @ 0.50 Bar
- MWCO: 0.75L/min @ 0.50 Bar
- Chemical reduction: Optional Activated Carbon Disc available to reduce chemical residues, i.e., pesticides, endocrine disrupting compounds, medical residues and heavy metals

The filter has a bit inclination because water does not remain tight in the middle of the filter and gravity can work.
Maintenance

When the filter is collapsed it has to be changed:

1. Remove screws
2. Remove collapsed filter
3. Collocate tubes and clamps correctly on the new filter
4. New filter
5. Fasten screws
6. Filter change is done

INDUSTRIAL PROCESS

Once the material selection is done, the industrial process can be studied.

Bottle stoppers will be of EPDM concretely Santoprene, this material can be modified by injection molding, sheet extrusion and profile extrusion. Finally injection molding is chosen because bottle stopper shape is much complicated to make in a sheet or profile extrusion.

Bags will be made of LDPE, but there are two different types of this material: one for make the bag and the other for make the neck. For execute the first one which is the material is laminar it should be cut and sew and then it could be united (with the other part of bag) by epoxy resins or heat-sealed vacuum-packed. The other part, neck, which its material is rigid, it will be fabricate through injection, the reason is the same as stoppers, its shape is too much complicated to make it by extrusion.

To unify bag and neck will be used heat-sealed vacuum-packed system as well as bag unification. Finally to assembly both bags the system used will be riveting.

To make the box and its cover, as they are PP it could be made by injection molding because is the best option. By thermoforming it could be an option but is not recommended because then nerves cannot extract.
PROPOSAL ADOPTED FOR

GENERAL DESCRIPTION

REGULATION
GENERAL DESCRIPTION

Bivalve is a bag which the main use is purifies water. It is practical, functional and easy to use. Its material is the main feature; it has the capacity to be roll up and this is good for a better transport. It is also suitable for communities of 5 people and it can be carried in different positions.

This product is composed of two main parts: bag and filter box, although there are more pieces to consider (bottle stopper, rope).

The bag is the main part of the product, thanks to its material it has the capacity to be roll up; moreover the material is transparent which is convenient to see purification process. The bag is divided in two parts: one is used for introduce dirty water and the other part is used to store purify water; at the end of each bag there are two bottle stoppers. Each bag is suitable to store 5 liters; this quantity is enough because people can filter more liters if they want. This bag is provided of two handles no very useful, they are more aesthetics than functional but they sometimes can be helpful.
The filter is the system which provides a good filtration. It is stored in a little box which its material is hard and watertight. This box is supplied with two filter subjec-
tions which their shape causes filter had a little bit slope and in this way water can
pass through the filter thanks to gravity and does not remain stagnant. For guaran-
tee a good watertight the filter is connected by two pipes subjected with clamps.

There are two bottle stoppers, as said before, each one for each bag. They are
watertight because of the system used, see on the image below. These two bottle
stoppers are subjected on the bottleneck for do not exchange themselves. Mo-


Rope is used as handle to carry Bivalve; it has multiple combinations because it can change it by a knot. The material used is soft and it is agreeable for skin when it is carried on although the user does not walk miles to get water. This rope is not only used to bring it, it is used to hang Bivalve at home and became a better filtration. Moreover, when the filter does not work, this rope can be reused as a wick to make torches (something necessary in this kind of situations) or bind...

REGULATIONS

Filter regulations

- US compliance EPA - US National Primary Drinking Water Regulations under the Safe Drinking Water Act 90-523
- UK compliance Water Supply (Water Quality) Regulations 2000
GRAPHIC STUDY

PIECES
PROPOSAL VIEWS
GENERAL VIEWS

ESTHETICS AND
GRAPHICS PROPOSAL
COLOUR AND TRIM
DRAWINGS
### PIECES

<table>
<thead>
<tr>
<th>QUANTITY</th>
<th>DIMENSIONS</th>
<th>MATERIAL</th>
<th>REGULATIONS</th>
</tr>
</thead>
</table>
| 4        | intern. diam. 17 mm  
extern. diam. 30 mm | PP | - |
| 4        | diam. 25-40 | Galvanized steel s/EN 10292 | DIN 3017 |
| 2        | diam. 32 | PP | - |
| 12       | diameter: 12 mm  
Length: 10.9 | STEEL | - |

<table>
<thead>
<tr>
<th>QUANTITY</th>
<th>DIMENSIONS</th>
<th>MATERIAL</th>
<th>REGULATIONS</th>
</tr>
</thead>
</table>
| 2        | intern. diam. : 63  
interior diam. : 55 | Santoprene | - |
| 2        | 761x443 | LDPE | - |
| 1        | 300x70 | PP | - |
### QUANTITY DIMENSIONS MATERIAL REGULATIONS

<table>
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<tr>
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<th>DIMENSIONS</th>
<th>MATERIAL</th>
<th>REGULATIONS</th>
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<tr>
<td>4</td>
<td></td>
<td>Galvanized Steel</td>
<td>DIN 7981</td>
</tr>
<tr>
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<td>Diameter: 30mm; Lenght: 170 mm</td>
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<td>-</td>
</tr>
<tr>
<td>2</td>
<td>Diameter: 16 mm; Lenght: 1.5 m</td>
<td>Cotton</td>
<td>-</td>
</tr>
<tr>
<td>1</td>
<td>300x100x50</td>
<td>PP</td>
<td>-</td>
</tr>
</tbody>
</table>

**Proposal Views**
ESTHETICS AND GRAPHICS PROPOSALS

For do not make mistakes when it comes to fill water inside the bag or empty it. The stoppers have a different colour although this particularity is not the only thing to distinguish from one another. There are two symbols: one for dirty water and the other one for clean water.

They are incrusted on the stopper, to this way, they will never removed.

DIRTY

CLEAN

These symbols are accepted for a big range of people who understand that the first one is non-potable water and the second one is potable water. Moreover there are the words “clean” and “dirty” to do it more evident.

The typography used is lineal because this kind of typography is easier to understand.
COLOUR AND TRIM

Colours used in Bivalve.

For the bottle stoppers there are two different colours, the reason is distinguish which has to be located on purify water side and dirty water side.

**PANTONE 2144 U**
- R: 79
- G: 153
- B: 188
- C: 73
- M: 36
- Y: 1
- K: 0

#1F486B

The colour used for filter box is also blue; this colour is chosen because in the box will become water purification. Although it will be darker than bottle stopper to get a whiff the water is not purified at all.

**PANTONE 410 C**
- R: 116
- G: 102
- B: 97
- C: 43
- M: 39
- Y: 39
- K: 15

#74666

This colour is a combination between brown and grey; these two colours are used to identify dirty water side. The colour brown is associated with wholesome, natural and organic produce and anything related to the great outdoors, agriculture and farming where become this “dirty” water used.

The colour used for filter box is also blue; this colour is chosen because in the box will become water purification. Although it will be darker than bottle stopper to get a whiff the water is not purified at all.

**PANTONE 410 C**
- R: 116
- G: 102
- B: 97
- C: 43
- M: 39
- Y: 39
- K: 15

#74666

Its meaning is everything related to water and purification. For this reason this is the color selected to identify water purified side.

Bivalve consist in different textures: the bag which is the main part, will be plastic laminar but its neck will be plastic rigid to take it well. Stoppers will have a soft texture and will be more flexible and easy to use and box texture is also rigid to be sturdy.
BIVALVE, HUMANITARIAN PROJECT. upc-epsevg

for the original size see on annex
INDUSTRIALIZATION STUDY
Industrialization process for bottle stopper is injection moulding.

The handicap of injection process is the difficulty to expel pieces because Santoprene is an EPDM and they are soft. Otherwise is the best method.

1. Granules of plastic powder (note the plastics listed above) are poured or fed into a hopper which stores it until it is needed.
2. A heater heats up the tube and when it reaches a high temperature a screw thread starts turning.
3. A motor turns a thread which pushes the granules along the heater section which melts then into a liquid. The liquid is forced into a mould where it cools into the shape.
4. The mould then opens and the unit is removed.

Bags will make of LDPE so, as said before, first of all a patron will be designed and then cut, it should cut 4 pieces for make one bag (two pieces for dirty water and two more for clean water) then is better united these two pieces by heat-sealed vacuum-packed.

For make the neck, injection molding is used. For one bag, two necks are necessary and they are also united with plastic by heat-sealed vacuum-packed. Finally to assembly both bags the system used will be riveting.

Riveting
1. Locate
Component parts are placed either manually or automatically onto the centre pin which acts as a spring loaded location guide.
2. Feed
Rivets are continuously fed from a hopper to the riveting head, via tracks which orientate the rivet correctly.
3. Set
A high integrity static joint can be obtained by using the maximum shank expansion in the component of a semi tubular rivet. Precision swivel joints can also be achieved by using punched tubular rivets and minimising shank expansion.
4. Eject
Workpiece is removed either manually or automatically, before the process returns to step 1.
Heat sealing package is widely used in daily chemical products, food, pharmaceu-
ticals and other fields. Since leakage usually occurs in the sealing area of the pac-
ackage in the process of product filling. And most of the breakage in actual application
also occurs in the sealing area. Therefore it is necessary to select proper materials
with suitable heat seal property to improve the integral barrier property and reduce
the rejection rate in the production line.

To make the box and its cover, as they are PP it could be made by injection moli-
ding because is the best option. By thermoforming it could be an option but is not
recommended because then, nerves cannot extract.

Finally to fix box and cover, four screws are colocated on the corners of the box.

RESISTANCE STUDY

The weakest part of the product is the hole where the rope is tied. For this reason it
has to be analyzed to put something to make it more resistant. In fact, only 2 upper
holes hold the entire weight so, just one will be analyzed. Therefore the force applied
will be the half.

Gravity aprox: 10 m/s²

Weight total = 5 l x 10 = 50N --> 25N
In consequence F will be 25N because it has to compense the weight.
BIVALVE, HUMANITARIAN PROJECT.

Maximum displacement: -0.0277 mm

Maximum strain: 1.928 MPa
Strain section away from the hole: 0.067 MPa

To be more precise, another mesh is done.

Maximum displacement: -0.0284 mm

Maximum strain: 2.379 MPa
Strain section away from the hole: 0.786 MPa

Finally we can see that the part near the hole has maximum strain, it was expected. For this reason we have to put a reinforce around the hole.
### Project Budget

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<tr>
<th>Material</th>
<th>Price/KG</th>
<th>Quantity</th>
<th>Cost</th>
<th>Price Machine</th>
<th>Unit</th>
<th>Cost (€)</th>
<th>Total Price</th>
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<tbody>
<tr>
<td>Santoprene</td>
<td>1.26€/kg</td>
<td>0.005 kg</td>
<td>0.006€</td>
<td>30 €/h</td>
<td>5 units</td>
<td>0.006€</td>
<td>0.031€</td>
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<tr>
<td>LDPE (neck)</td>
<td>3.00€/kg</td>
<td>0.0025 kg</td>
<td>0.005€</td>
<td>30 €/h</td>
<td>5 units</td>
<td>0.041€</td>
<td>0.207€</td>
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<tr>
<td>LDPE (bag)</td>
<td>3€/m</td>
<td>2 bags</td>
<td>1.5€</td>
<td>Manipulation</td>
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<td>1.7€</td>
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<td>PP</td>
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<td>0.102 kg</td>
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<tr>
<td>4 units</td>
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<tr>
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<td>4 units</td>
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<td>3 m</td>
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<tr>
<td>12 units</td>
<td>0.02€</td>
<td>0.24€</td>
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<tr>
<td>60 cm</td>
<td>1.20€</td>
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</table>

Bivalve Humanitarian Project - UPC - EPSEVG
TOTAL PRICE: 33.89 €
It is only a price of components cost. A 20% of this price is applied for the previous investment.

33.89 € * 1.2 (investment) = 40.67 €

40.67 € * 1.3 = 52.87 € (30% manufacturer benefit)
52.87 € * 1.4 benefit = 74.01 € (40% seller benefit)

PVP: 74.01 €
Taxes are not applied, because every country has its own taxes, even so in Philippines sales tax is 12% although normally it is imported from other countries because it is humanitarian aid.

After my project done, I know there are some fields to improve.

I could design a system to transport Bivalve better, so good packaging for an easy transport like a box or something similar to put them inside.

Another improvement could be the filter system. If the filter position was vertical the filtration would be faster although Bivalve geometry should be changed.

Maybe if the product was static (it always stays on the same place) the volume it could be bigger and also the concept could be changed and be useful for more people like a big community. So, referring to this idea, on future new ranges of this product could be made.
After the end of the project it can be conclude that the main target has been reached correctly. Should also be mentioned that during the project realization some other targets have emerged because of increasing knowledge about the subject of the product. This makes in spite of successfully completed initial targets of the project, it can be further developed and evolve.

Thanks to analysis of the problem it can be said that countries which suffer natural catastrophes can be a good destination for new products due to lots of needs. Following this field, the work of NGOs and the importance of transport are two things seen at the beginning of the project. So referring that, is complicated design a product for a user in a context you never been and all the information acquired is by organizations implied in the problem. Otherwise it is a challenge and I think it is a good thing to do as a final degree project.

The product is cheaper than other purifiers and the logistic is optimized because it can reduce its dimension 50% when it is folded.

Finally say that the most complicated part has been design the technology applied but realize this project has been good and I have learnt many things. Moreover do this work alone has been good because I have could know my limits and my possibilities.

CONCLUSIONS

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DIRECTOR: Frederic Vilà

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COMMENTS: