

# FLUID DISINFECTION SYSTEM USING UV TECHNOLOGY

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## Abstract

This report gives an overview of a system which is going to be used to clean water from bacterias, viruses and other pathogenic cells. In order to do that we chose UV technology. Water in the system is driven by a pressure pump and whole system is controlled by PLC

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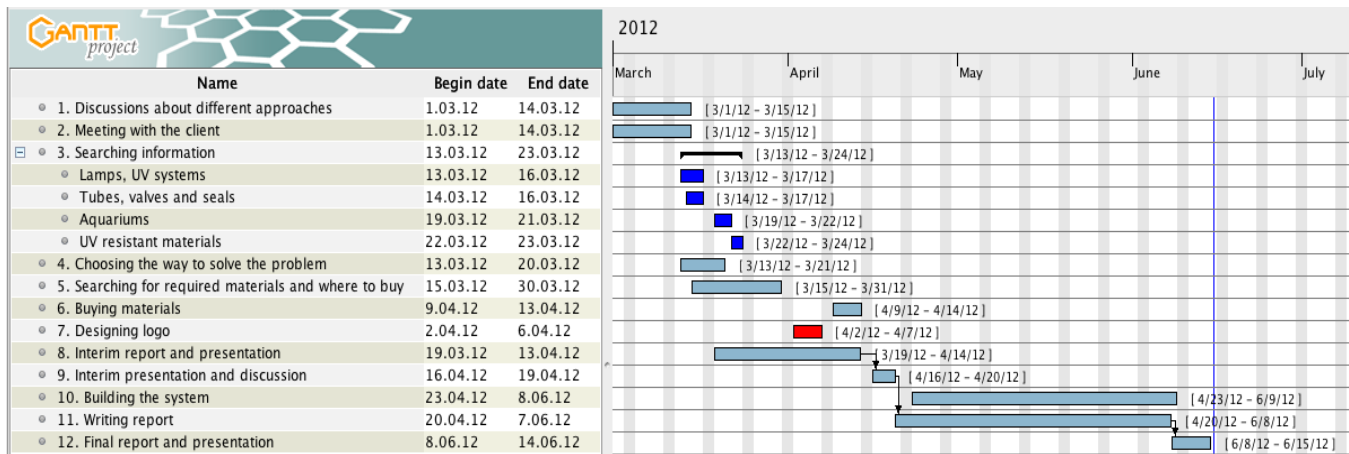
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# 1. GROUP PRESENTATION AND TEAM ROLES

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## 2. GANTT CHART



The gantt chart with all tasks and dates of our work, which we made on the beginning of the project, proves that we did most required tasks on time. The only task that we did not finish on time is searching for required materials. Unfortunately, looking for materials in local shops and companies turned out to be more difficult than we expected. Now, we dealt with this problem and created initial list of materials so we assume that we are in good place to develop our system and made final report and presentation on time.

## 3. GLOSSARY

**Water disinfection system based on UV radiation** - Water disinfection with UV rays or ultraviolet light is a purely physical process and is a continuous method (cruising) in the radiant chamber. Microorganisms such as bacteria, viruses, yeasts, etc., subject to the effective UVC rays are irradiated in a few seconds deactivation. This means that in the cells (DNA, RNA) is activated by photochemical reactions, which inhibit the processes necessary for life and thus inactivate microorganisms. Therefore, for effective disinfection is conclusive reductively equivalent dose of irradiation. This term is understood as defined in the irradiated area average dose.

**UV radiation** - Ultraviolet (UV) light is electromagnetic radiation with a wavelength shorter than that of visible light, but longer than X-rays, in the range 10 nm to 400 nm, and energies from 3 eV to 124 eV. In this case is used radiation with a wavelength of 254 nm. At this wavelength there is a maximum absorption of micro-organisms, which results in bactericidal activity.

**Modular system** - System composed of independent functional modules.

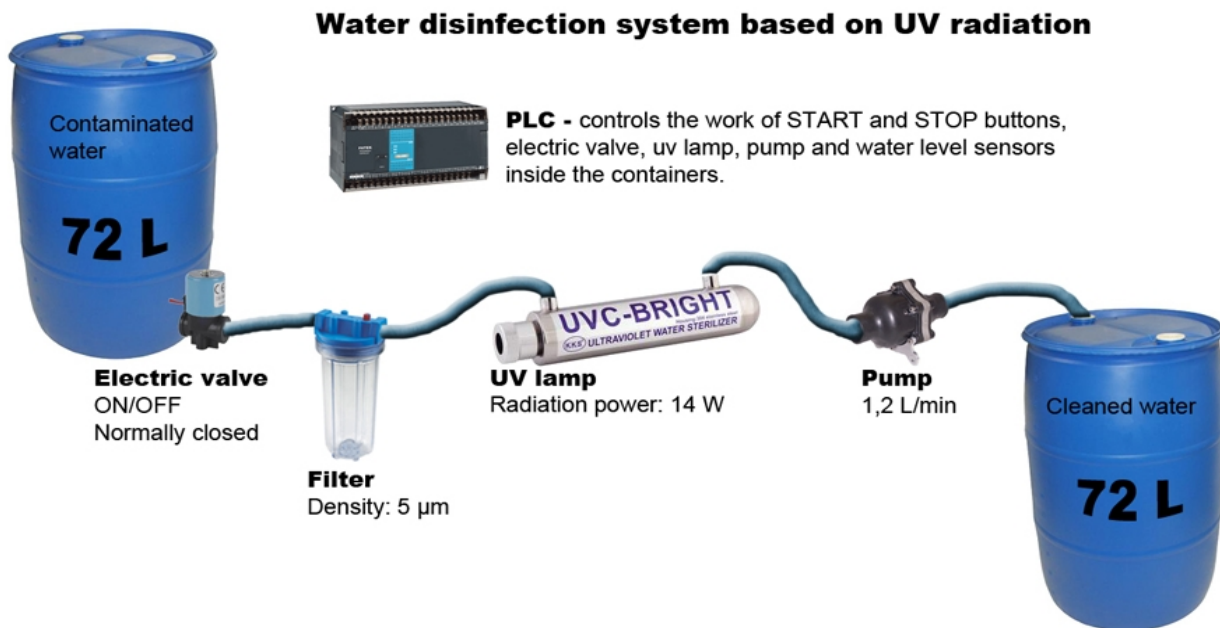
**PLC** - Programmable Logic Controller or programmable controller is a digital computer used for automation of electromechanical processes, such as control of machinery on factory assembly lines, amusement rides, or light fixtures.

## 4. INTRODUCTION

Nowadays, all over the world, everybody are increasingly seeking different ways, how to disinfect, clean and reuse contaminated water. There are several application and approaches for cleaning the water, like using chemicals (chlorine, ozone), UV lamps and filtering.

The objective of our project is to build and develop a fluid disinfection system which will remove bacterias, viruses and seaweeds using UV radiation. We decided on that method of removing microorganism, because it is the most advantageous and fully satisfies our target. Our client, who is going to use the system in future research, is the Chemical Engineering Department. We are supposed to design such a system taking into consideration all specifications provided by the client. The system must work for 72 liters per hour with continuous flow-rate. Our aim is to build a system which will be as inexpensive as possible and the most applicable in the future. We intend to use some equipment offered by the Chemical Engineering Department.

The graph below presents suggested by us solution:



Final product will be used in greenhouse at Insitituto Politecnico do Porto, but it will be universal and can be modified to be adaptable to every laboratory with similar needs.

## 5. STATE OF THE ART

On the market there are many different systems for purifying contaminated water. Most of them are designed for industrial use. It means, that the fluid volumes are very big and these systems take a lot of room and are expensive. More similar to our idea are systems that have been developed for cleaning the water in pools and ponds. Also systems that are used in aquariums. Our idea is build a modular system, so every part can be changed easily and different extra devices or equipment can be added if needed. Like chemical cleaning/filtering. Main idea is to build a modular system based on UV radiation because it's sufficient and effective. And because of the small volumes, our system should be also small and compact to fit in laboratories.

Our system differs from the existing solutions in the sense that it is compact, simple, small and modular. And also, it's built according the needs of our client. In this case the system is also automated.

## 6. MARKETING PLAN

### 6.1 COMPETITORS ANALYSIS

Competitor environment

Around the world are plenty of companies which provide service of fluid disinfection using UV technology. Those companies are focused on worldwide service in industry and municipal environment. They provide service on extremely big scale with different applications:

- municipal: drinking water, beverage industry, swimming pool water treatment,
- industry: medical, pharmaceutical, industrial wastewater, aquaculture,

Examples of worldwide companies which provide UV technology is following:

- Enaqua

- WEDECO
- Hanovia
- Kurion
- Inflico
- Aquionics

Each of these companies patented their own UV technology and method of application. Most of them use not only fluid disinfection by UV technology but also other methods like ozone systems or reverse osmosis. They provide plenty of different products for numerous different applications. Those companies are focused on mass production and distribution. They have large budget and broad teams of specialists and workers.

#### Competitor advantage

The advantage of our product and service is that we are focused only on one specific area: fluid disinfection using germicidal UV lamp. We are also looking more for individual clients like chemical laboratories or small companies. Thanks to the modularity characteristic of our project we can adjust our product to every client. The idea of our work is not to create our own UV technology but build a system from available equipments on the market and selling the service. All parts can be imposed and ordered by an individual client. Stakeholders have the possibility to choose the best materials and technology depending on their budget and needs. The task of our team is to build such a system for a client and provide the service. Our clients can always count on our technical support to maintain the system. In comparison to high advanced companies, the price of our service would be low and materials are chosen by clients so they decide on what price they can afford.

#### Conclusions

To conclude, there are plenty of companies providing UV technology for fluid disinfection and taking into consideration our budget, promotion strategy, used equipment and automation we cannot compete with them. The objective and innovation of our project is to sell flexible a service for individual clients. We believe that this strategy will be profitable on the current market.

## 6.2 SWOT ANALYSIS

<p><b><u>Strenghts</u></b></p> <p><b>M</b>aterials and equipment can be chosen by individual clients</p> <p><b>P</b>roject has clear objective and idea how the product and service should look like</p> <p><b>We</b> provide modular system which can be adjust to individual client</p>	<p><b><u>Weaknesses</u></b></p> <p><b>L</b>ack of experience</p> <p><b>L</b>ack of knowledge in chemical and electrical field</p> <p><b>P</b>ossible problem with product distribution</p> <p><b>T</b>ime limitation</p>
<p><b><u>Opportunities</u></b></p> <p><b>G</b>aining new knowledge and experience in this field</p> <p><b>D</b>eveloping and improving the product and service</p> <p><b>I</b>mproving communication and organization skills</p> <p><b>O</b>pportunity of great profit</p>	<p><b><u>Threats</u></b></p> <p><b>M</b>arket demand is limited</p> <p><b>B</b>ig competition on the market</p> <p><b>L</b>imitation in product promotion</p> <p><b>P</b>ossible negative reaction on the market</p> <p><b>F</b>inancial and human limitations</p>

## 6.3 EVALUATING MARKETING OBJECTIVES

### 6.3.1 COSTUMER SEGMENTATION

Our typical clients are university laboratories and also smaller domestic and small business laboratories in Portugal. More precisely laboratories which are growing different bacterias and wants to use the same water after the experiments. So the main clients are biology and chemical departments in different universities and polytechnic institutes. There are approximately 50 this kind of departments in Portugal.



Most of the universities are state funded and usually it means that they have tight budgets.

Client needs:

- the service and product together are as cheap as possible;
- it should be modular (to change or add different filters, tanks, equipment);
- easy to use;
- easy to maintain;
- compact - because the lack of space in laboratories

### 6.3.2 MARKET POSITIONING

Our product and service can satisfy all the above points. Even more, we are willing to make any changes to our system and work out new solutions with our clients to meet all their needs. And because the system is easy and simple, it is also reliable.

We differ from other similar companies in flexibility. We are small and we take one project at a time and focus only on that to work out and give the best results to our client.

### 6.3.3 MARKETING OBJECTIVES

- Discover the national market
- Enter and expand the market with new product
- Advertise the product
- Design our product according to needs of the potential clients.
- Keep developing our system, make new versions
- Make research on the national market to get more
- Make the service.

## 6.4 MARKETING PROGRAM

When the prototype will be done for the chemical laboratory of ISEP, we will have a working fluid disinfection system, which can clean at least 72 liters per hour. We will sell it on the national market. First we have to make a web page in two languages ( english and portuguese ), which introduces our system, describes how it works, tells about the advantages. We want to sell our products only on the internet, because we don't have enough money to keep a shop or an office, so our web page will has a webshop function, where the clients can buy and customize their product. We will buy position in google. Besides of the internet advertising, we will participate also on fairs and print posters. We will offer 2 years of guarantee and full service of maintenance. The clients have to pay for service after the guarantee is over. In this case, our product has an advantage, that it has modular system, which can save money for the clients. Will also have costumer support.

Our goals are as follow:

- Expand the national market
- Develop the system with new ideas
- Personal promotion for the potential clients
- Obtain costumer satisfaction
- Being competitive

## 6.5 MARKETING MIX

### 6.5.1 ABOUT OUR PRODUCT

Our product is a fluid disinfection system based on UV radiation system. It will be able to clear 72 liter of fluid per hour. The fluid from the first container goes trough a filter system and an UV lamp with spiral motion. When it is cleaned the water goes to another container with the help of a pump. The system has PLC control system.

### 6.5.2 PRICE

Setting the price is always hard for a company, we tried to make it not so high, because if it is too high, nobody will buy it. Our total cost is around 699,9 euros , which includes:

- the material costs
- advertising

- the packaging,
- the VAT
- profit.

Above all we will give 10 % discount for those costumers, who buys at least 3 systems.

### 6.5.3 PROMOTION

We would like to use various type of promotions. We will print posters, leaflet, web advertisement, participate on fairs, visit some potential clients . We also thought about the following slogans :

- Invisible but working!
- Working invisible!
- Pure in action !
- Clear by light !
- Let the UV does the dirty job !

We will build a webpage for the product, and pay for the positioning to google, because it is easier for the client, to find us. We will also search some magazines to test and write a critic about our product.

### 6.5.4 PLACE OF TRADING

Our field of trading will be the internet, because we don't have enough money to keep a shop. Our webpage will have a webshop function, where the clients can buy and customize their products. We will also give 2 years of guarantee and 30 days for try. When the product gets popular and we will have enough clients we can open a shop near shopping streets.

## 6.6 SUMMARY

According to the needs we decided to build a fluid disinfection system which is based on the newest and most environmental technology: the UV radiation. The main advantage of our product is the modular system and the cheap maintenance. We are totally flexible to customize the product and adapt new ideas. Our fluid disinfection system has great potential to satisfy the customers.

## 7. ECO-EFFICIENCY MEASURES FOR SUSTAINABILITY

Systems which we build are based on the idea of sustainable development which means:

**THE WAY YOU THINKING, YOUR WAY TO SAVE!**

There are mass-production products which are cheap, as well as more advanced and expensive system. The availability of so many applications is a challenge for us.

Seeking new applications and solutions development is the main objective of our group. Experience and qualifications are our response to your individual and specific needs.

Our only competitor is your time and your knowledge, which gives you the opportunity to find better solutions than our.

We suggest you offer based on the following assumptions and actions:

### **UV technology:**

The main idea of our systems is the use of UV lamps. As the water disinfected by this method is re-exposed to biological contamination is possible to apply methods of support. Nevertheless we try reduced them to a minimum despite the invaluable advantages of UV technology. It is safe alternative for dosing sodium hypochlorite for disinfection, or other chemicals. There is no need for storage, transportation and handling of hazardous chemicals. All such devices do not require mechanical cleaning of casing pipes, which greatly simplifies their use and makes it much cheaper.

UV sterilization lamps are widely used in the world to disinfect water without using heat and chemicals. Disinfection of water in the local scenes, factories, hospitals and laboratories. UV lamps can replace pasteurizers in breweries, mineral water bottling plants, processing plants food, at a fraction of operating costs. These devices provide a sterilizing, disinfecting water in conventional greenhouses and closed loop with drainage. Ultraviolet sterilization in the swimming pools provides chlorination or the abandonment of several dosing reduces the amount

of chlorine. Use in ponds and fountains protected from rotting. UV lamps are also used for the destruction of ozone in ozone water.

The main advantages of UV sterilization lamps:

- Devices using UV radiation of wavelength 254 nm damage DNA, which is lethal to microorganisms. The use of one wave length protein protects against decay.
- Do not cause any changes in the chemical composition of water.
- You can not overdose.
- Low operating costs.
- No hassles with chlorine and corrosion.
- Some pathogens such as Cryptosporidium are resistant to chlorination.

### **Search your trash:**

Getting to know your needs and the environment, we seek the best way to use things that have and do not use often to be administered to our system. We buy only what is necessary to expand your options while thinking about the possibility of these things in the future for other applications.

### **Modular systems**

We build simple in design and possible to dismantle system. It gives possibility to include additional parts and reuse some parts to other applications. Modules can easily be moved and then put back in place without disturbing any other parts of the system. Our lamps UV can be mounted vertically and horizontally, and at any angle to suit your needs. Installation and removal of our equipment does not require the use of sophisticated instrumentation. The whole can be easily assembled (removed) by hand.

### **Local products**

We've been studied the local market in search of small and specialized companies with whom we can establish cooperation based on mutual relations. In this way, we are looking for many new and interesting solutions as an alternative way to mass production.

### **Friendly materials**

We discover local producers and production technologies. We are looking for materials and manufacturing them friendly people and the environment. As the financial capacity to invest in quality materials of known origin. Used for the production of materials and technical solutions guarantee a long and very economical operation of these devices. We believe that the machines are likeable and work on good equipment brings pleasure. From experience we know that people care more about the equipment that they like. This extends its lifetime. In addition, we always

choose ergonomics and healthy. All this to make the working environment more pleasant place. It is up to you how much money you destine for your system. Our task is to use them as best as we can.

### Energy savings

We focus on water technologies using light that does not require bulky machinery. Expenses incurred for the purchase of the UV sterilizer be recouped very quickly in the form of lower energy costs, which must be supplied with thermal sterilization. Using this method also reduces the energy input to operate, transport and maintenance.

**We do not offer savings, but investment in the future.**

## 7. LIST OF MATERIALS

The table below presents suggested by us initial list of materials to build our system:

	Product	Specification	Units	Price	Price with VAT	Shop
1	Pump	1.2l/min	1	45,32	55,74	PeçaFiltros
2	Filter	outside layer	1	13,16	16,19	PeçaFiltros
3	Filtrating element	5 micrometers	1	4,24	5,22	PeçaFiltros
4	Tube	diameter 6mm	3m	1,49	1,83	PeçaFiltros
5	ON/ OFF valve	Electric, normally closed	1	12	14,76	PeçaFiltros
6	UV lamp	Radiation power: 14 W	1	169,74	208,78	PeçaFiltros
7	Adapter	Tube connector, 6mm	6	5,57	6,85	PeçaFiltros
8	Water level sensor	Electric, ON/ OFF	2	6,4	7,87	PeçaFiltros
9	Adapter	Container-tube, 6mm	2	4,06	4,99	PeçaFiltros
		TOTAL:		261,98	<b>322,24</b>	
10	Trolley					
11	Start button					
12	Stop button					
13	Chemical test equipment					