WATER TREATMENT BY MAGNETIC CONDITIONER

PROJECT REPORT

Submitted by

AMALA K PAUL

ANEESHA POORNIMA M

KANIMOZHI L

KARTHICK RAJA P

in partial fulfillment for the award of the degree

of

BACHELOR OF ENGINEERING

in

AGRICULTURE ENGINEERING

SRISHAKTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

COIMBATORE-641062

ANNA UNIVERSITY:CHENNAI 600025

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BONAFIDE CERTIFICATE

Certified that this project report titled **“WATER TREATMENT BY MAGNETIC CONDITIONER”** is a bonafide work of **“AMALA K PAUL(714016108009), ANEESHA POORNIMA.M (714016108013),KANIMOZHI.L (714016108051)** and **KARTHICK RAJA.P (714016108054)”** who have carried out this project under my supervision.

Signature	**Signature**
Dr.RANEESH.K.Y	**Dr.A.TAJUDDIN**
HEAD OF THE DEPARTMENT	**PROJECT SUPERVISOR**
Agriculture Engineering Dept.	Agriculture Engineering Dept.
Sri Shakthi Institute of Engineering	Sri Shakthi Institute of Engineering
And Technology	And Technology
Coimbatore-641062	Coimbatore-641062

Submitted for Anna university project viva voce examination held on**…………..**

INTERNAL EXAMINER **EXTERNAL EXAMINER**

ABSTRACT

The project "water treatment by magnetic conditioner" is a boon to farmers in such a way that agriculture can be carried out without using fertilizers. A comparitive study among a student made electromagnetic conditioner,a magnetic conditioner available in the market(provided by manufacturing company) as well as non treated water was made in a field with the cultivation of radish (Raphanus raphanistrum). The crop was chosen as it can be harvested in 45-50days.

Six plots of land were cultivated and irrigated at random with nontreated water,water treated with student made magnetic conditioner and water treated with magnetic conditioner provided by the company. The project is carried out by the industrial collaboration with 'Geo enviro solutions Ltd'.

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ACKNOWLEDGEMENT

We expressour deep sense of gratitude to the Chairman **Dr.S.Thangavelu** for his invaluable guidance and blessings in the project work.

We are tremendously thankful to the secretary **Mr.T.Dheepan,** joint secretary **Mr.T.Sheelan,** Principal **Dr.R.Prakash,**Academic director **Dr.R.Manian**for their unwavering support during the entire course of this project work.

We are grateful to the Head of our department, **Dr.Raneesh.K.Y** who modelled us both technically and morally for achieving greater success in life.

We express our sincere thanks to our project co-ordinator **Er.S.Ganesh** and projectguide **Dr.A.Tajuddin** – Department of Agriculture Engineering for his constant encouragement and support throughout our course, especially for the useful suggestions during the course of project period.

We are also thankful to all the staff members of our department and technicians for their valuable assistance. Finally, we take this opportunity to extend our deep appreciation to our family and friends, for that they meant to us during the crucial times of the completion of our project into a successful one and we conclude our thanks to God for providing better situations.

AMALA K PAUL

ANEESHA POORNIMA.M

KANIMOZHI.L

KARTHICK RAJA.P

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CHAPTER I
INTRODUCTION

The main objective of the project is to perform irrigation and to study about the growth rate of the crop with the help of electromagnets and permanent magnets.For a healthy and environment the food which people eat should be organic.But,because of agriculture land reduction fertilizer intrusion played a great role in increasing crop productivity.

Usage of fertilizers made the land sterile.Also fertilizer costs have raised higher.In this project the need of fertilizer is completely avoided because the complete nutrients are fed to the plants by using water that is sent through water conditioners.

Usually the demand only lies with the quantity but not about the quality.Fertilizers causes quality degradation.This project removes these disadvantages and enhances the nutrition content of the plant.

Nowadays farmers move on to the orgainc farming due to following reasons.

i. To improve human health
ii. To manage soil fertility
iii. To prevent soil degradaion
iv. To reduce the fertilizer application
v. To reduce the production cost
vi. To increase the quality and quantity of production
vii. To achieve the maximum crop yield
viii. To reduce the pollution
ix. To enhance the socio economic status of farmers

1.1 Problem statement

While taking over this project we found that, in spite knowing about the fertilizer hazardness farmer still uses fertilizer because of illiteracy about the organic methods and also they are forced to use it,so that the yield is made higher within short duration.This problem arises with the fertilizer production industries which holds the control of the agriculture production.

1.2 Justification

Today,many people are aware about the fertilizer defects and are moving towards the organic farming.The focus about the quantity of the project is changing towards the quality.Irrigation done by magnetic conditioners is one of the methods which increases the quality of the crop without using fertilizer.

1.3 Objective

The main objective is to increase the subroots of the crop and to reduce scale formations over the ground as well as nearer to the root zone.Another need for this project is to increase crop productivity and quality.

1.4 Scope of the project

i. Reduction in crop nutrient degradation.
ii. Promotes soil desalination.
iii. Allows to use in all types of soil.
iv. Doubles shelf life of produce.

1.5 Advantages

i. Evironmentally friendly.
ii. No chemicals are used.
iii. No adverse effects.
iv. Fully customizable.
v. Easy installation.
vi. No maintanence is needed.
vii. Clogging within the pipe is completely eliminated.
viii. The cost of conditioner is low.
ix. No technical skill is needed for the farmer in order to use it.
x. Quality of the produce is enhanced.

CHAPTER II
REVIEW OF LITERATURE

Introduction

In this chapter, we present a collection of published information, methods on irrigation system related areas of research, such as books and journal articles. This review identifies, evaluates and synthesis the relevant literature. It shows how knowledge has developed within the field, highlighting what has already been done, what is generally accepted, what is emerging and what is the current state of the irrigation system.

Mostly, review of literature is associated with academic oriented literature; usually it precedes a research proposal and result section. Aim of the literature review is to bring the reader up to date with current literature on a topic and form the basis for another goal. A well-structured literature review is formed by a logical flow of ideas, current and relevant references with consistent, appropriate referencing style and proper use of terminology and an unbiased and comprehensive view of the previous research on the topic. Literature on the utilization of digital and printed resources and other related issues is given below.

2.1 History of magnetised water

Michael Faraday was the first researcher who seriously dug into magneto chemistry beginning in 1863. From 1890 and onwards, the subject of magnetically treating water had become extremely controversial, and was labeled “gadgetry” and “not sustainable under scientific scrutiny”. A company called Solavite, based in France, began to market a MTD in 1936. In the Eastern Bloc Countries, particularly Russia,increased research and applications of MTDs began after the Second World War. This was largely due to the fact that the U.S.S.R did not have the chemical expertise or funding to treat their water chemically like that in the U.S.A. (Lobley, 1990) .There have been manysuccessful industrial applications of MTDs in the west, including systems for NASA, yet the treatment has not been released mainstream or accepted by the Water Quality Association (Federal Technology Alert, 1996).

2.2 Principle of magnetic field on water

The principle of MWT is referring to various aspects. According to Busch et al. (1996), MWT principle is associated with Faraday's Law, which considers the changes in voltage and current of conducting solutions that pass through magnetic field. Faraday's Law formula is $E = v \times B$, where E is electric field vector, v is fluid linear velocity and B is magnetic induction vector. The magnetic application is also related to the physics of interaction between a magnetic field and a moving electric charge ion, which can be known as the theory of Lorentz's force, where Lorentz force is $FL = q\,|B \times v|$, where q is quantity of charged ion, B is magnetic induction and v is flow velocity. In support of this principle,Parsons et al. (1997) demonstrated that the maximum effect of magnetic field would occur when B and v were perpendicular to each other.Gholizadeh et al. (1998) found that the magnetic field caused the ion particles to collide with each other, and the redirection of the particles tended to increase the frequency of ions with opposite charge to collide and combined to form a mineral precipitate or insoluble compound (Alimi et al., 2000).

2.3 Property changes of magnetic water conditioners

2.3.1 pH change

Changes in the pH of distilled water of up to 0.4 pH units have been reported .Yamashita et al. (2003) witnessed, what he considered, slow and large pH fluctuations (0.05-0.1) during the first However Quickenden (2003) found no pH change in double distilled water subjected to a very strong magnetic field of

24 000 Gauss. Yamashita et al. (2003) witnessed, what he considered, slow and large pH fluctuations (0.05-0.1) during the first several hours of magnetically treating distilled water. His results indicated that to accurately evaluate the effects of magnetic fields on water, subtle experimental conditions such as field conditions produced by common lab devices and procedures cannot be ignored. He also states that extending measurements beyond several hours may be essential to observe accurately the effects of magnetizing water.From these experiments, it appears the fluctuations in pH change from experiment to experiment suggest that unforeseen interactions are contributing to pH change. While pH change may be an indicator for magnetically treated water in some situations, it cannot be solely relied upon.

2.3.2 Surface tension

Cho & Lee (2005) studied the effects of amount of magnetic treatment by a permanent magnet on surface tension. Two separate experiments were conducted: one was the measurement of surface tension and the other was a flow-visualization of dye behaviour in water samples. Both experiments showed that as the number of treatments increased, the surface tension of the sample decreased. Otsuka et al. (2006) concluded that no changes in properties of pure water, distilled from ultrapure water in vacuum, were observed after magnetic treatment. However, when the same magnetic treatment was carried out after the distilled water was exposed to O2, properties such as surface tension were change.Amiri & Dadkhah (2006) first noticed a sizeable change in surface tension in relation to magnetic treatment, but after further investigations determined that impurities from the TYGON plastic pipe used were contributing to the surface tension modification. This was concluded due to the fact that water passed through the same apparatus without the permanent magnet mirrored the characteristics of the sample magnetized. Amiri & Dadkhah (2006) findings are very important in regards to testing the effects of MTD's. To limit the chance of results being influenced by different contact materials, the sample being compared to the magnetized water should always be run through the same MTD apparatus minus the permanent magnets. If the modified properties are evident in both samples, then the change is due to an effect from the apparatus and not the magnetic field. Sueda et al. (2007) examined the maximum mass and diameter of a dripped water droplet on the tip of a glass capillary, and found both were affected strongly by magnetic fields.

2.3.3 Other physical properties

It has been shown that the water vaporization rate, an essential process for all biological processes, is significantly affected by the application of a static magnetic according to Nakagawa et al (2008). It has been reported by Nakagawa et al (2008) that the dissolution rate into water of oxygen is significantly accelerated by the presence of a magnetic field. Applying an increasing magnetic field to water can also reduce critical supercooling and prompt equilibrium solidification when the strength of the magnetic field is higher than 0.5 T. Studies by Lee et al (2009) and have found that the size of the water clusters, changes when exposed to a magnetic field.

2.4 scale reduction

Scaling problems from hard water in heating or cooling systems can heavily reduce the efficiency of the system in two ways. First it can reduce the heat transfer rate with the formation of an insulating deposit on a heat transfer surface significantly reducing the cooling or heating efficiency of the equipment. Secondly it can block pipes, condenser tubes or other openings decreasing flow rate and pumping efficiency.According to Smith (2010) the cost involved due to heat transfer inefficiency and the removal of scale in Britain alone was estimated at £1 billion per annum in the early 90's. A 25mm thick CaCO3 scale layer can decrease the heat transfer by 95%,Properly installed and configured MTDs have had many successes in reducing the amount of scale build up in pipes. In an experiment performed by Smith (2010), permanent magnets reduced the formation of scale in 6 out of 6 hot-water storage tanks with an average of 34% .The maximum reduction was 70% and the minimum reduction was 17%.Lipusa & Dobersekb, (2011) attained successful results, with the scale on a heating copperpipe spiral being 2.5 times thinner due to Magnetic Water Treatment (MWT) compared with untreated water.

2.5 Agricultural benefits

Bogatin's et al (2014) analysis showed that the main effects of magnetised water were the increase of the number of crystallization centres and the change of the free gas content.Degassing of water increases permeability in soil which results in an appreciable increase in irrigation efficiency.According to Bogatin et al (2015) an increase in the amount of CO_2 and H+ in alkaline soils is similar to the addition of fertilizers. In wet soil, CO_2 forms $H_2 CO_3$, which converts insoluble carbonates into soluble bicarbonates. Bicarbonates exchange with Na of the cation exchange complex. As a result of the exchange reaction, Na is removed from cation exchange complex into the soil, which improves properties of alkaline soils and accelerates their leaching.Bogatin (2015) concludes from their findings that MWT induces an increased yield by 10-15%, a more intensive root formation, the transfer of phosphorus fertilizers into more soluble form and a decrease in the risk of secondary salinification of soil. The magnetic treatment improves conditions of root layers due to (a) leaching of superfluous salts (b) better permeability of irrigated water and (c) better dissociation of mineral fertilizers.Lin & Yotvat(2016) experimented on the effects of magnetised water in agriculture with tests done experimentally established agricultural sites. In regards to using magnetic water for stock drinking supply.

CHAPTER III
MATERIALS AND METHODS

Introduction

The main aim of the project "Water treatment by magnetic conditioner" is to develop a magnetic water conditioner which helps to increase the overall crop productivity by providing good quality irrigation water to farmers. The materials and essential components in making this machine are discussed in this chapter. The materials are selected and filtered with the conceptualization and design with their line diagram.

Methodology

Methodology is the way of steps followed from starting to ending. The steps which are followed are displayed below. The flow chart helps to do the process clearly. Chapter III explains the components and working procedure of the magnetic water conditioner.

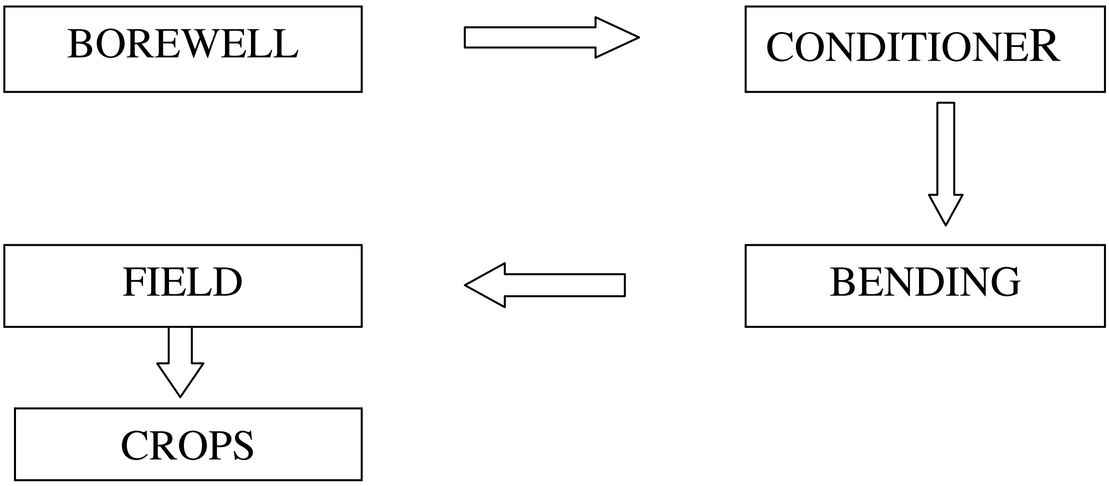


Figure 3.1 Flowchart

3.1 Conceptual design

The conceptual design and isometric view of magnetic water conditioner is done with Solid works 2018 software. It is analyzed and the conceptual design is shown. The conceptual design parts and isometric view of magnetic water conditioner is shown.

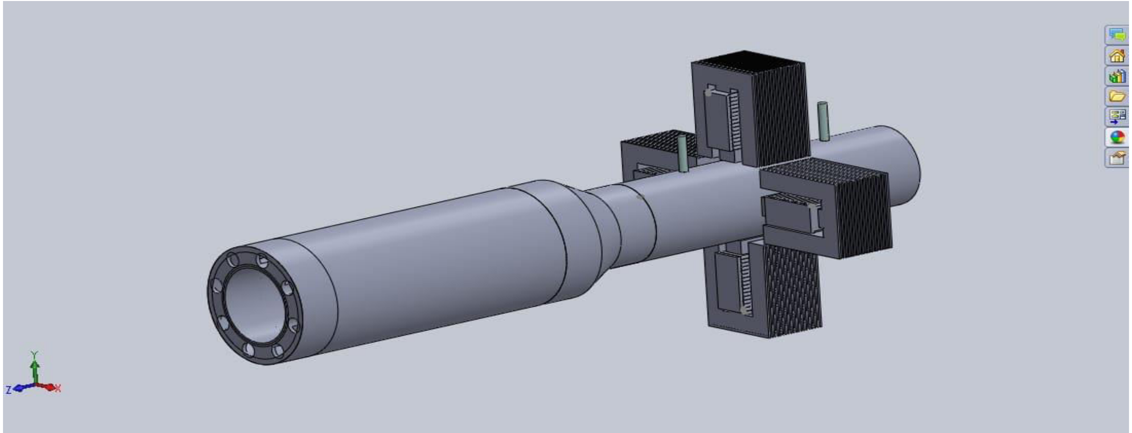


Figure 3.2 Conceptual design

3.2 Components

The magnetic water conditioner consists of following components to fulfill the requirement of complete operation.

i. Coupling
ii. Electromagnet
iii. Pipe 1 & Pipe 2
iv. Ionization rod
v. Ferrite magnet
vi. Neodymium magnet
vii. Reducer

3.2.1 Coupling

A coupling is a short length of tube with socket at either or both the ends which makes it possible to join pipes or tubes through welding,brazing or soldering. A coupling is very important in the fabrication of magnetic water conditioner as it connects the larger and smaller pipes together.

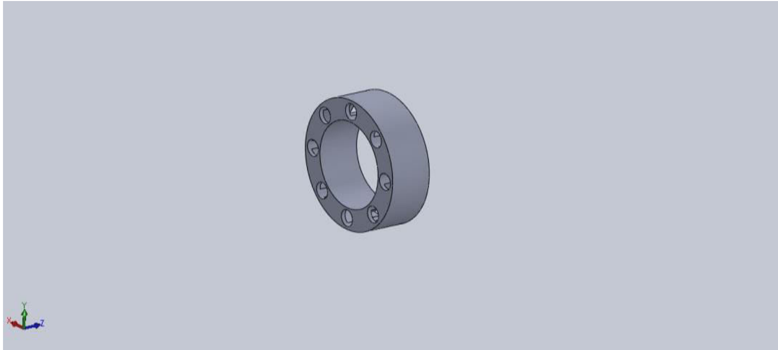


Figure 3.3 Coupling

3.2.2 Electromagnet

The electromagnet consists an aluminium core wounded with copper winding. It is one of the main working element of the magnetic water conditioner. It causes ionization of water molecules as a result by which the molecules get separated.

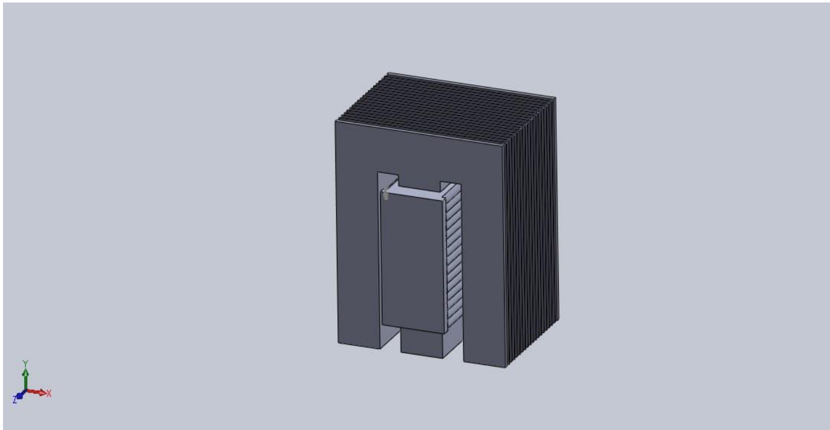
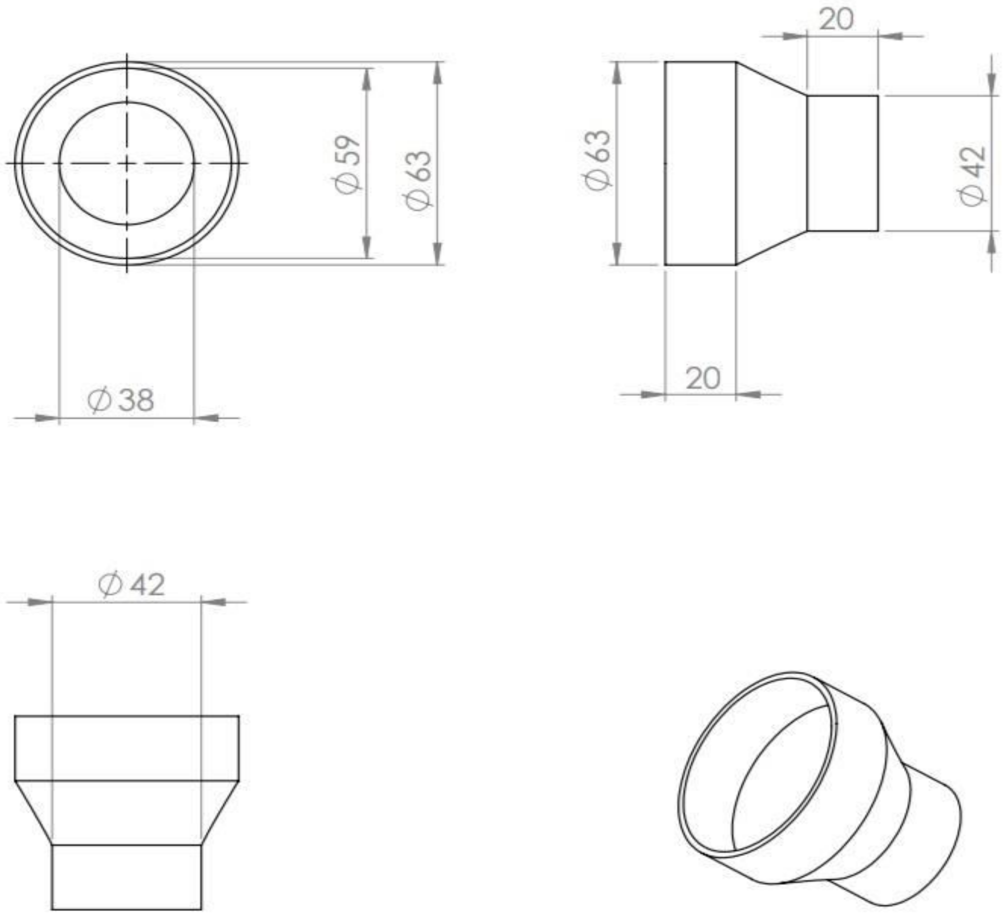


Figure 3.4 Electromagnet



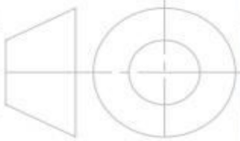
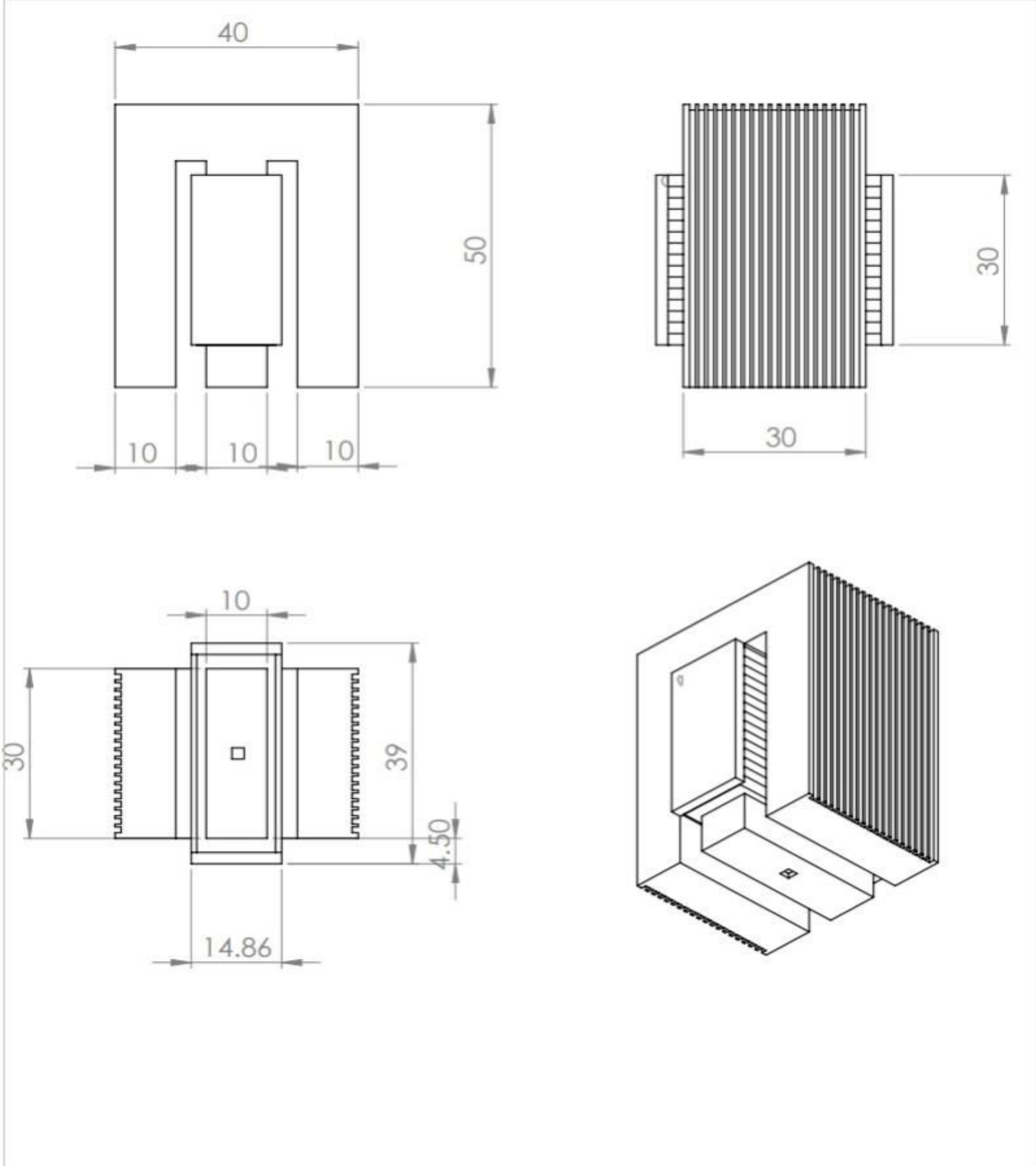
PROJECT NAME	WATER TREATMENT BYMAGNETIC CONDITIONER			
STUDENT'S NAME	**REGISTER NO.**	**SCALE 1:1**	**PART NAME**	COUPLING
AMALA K PAUL	**714016108009**		**PART NO**	01
ANEESHA POORNIMA M	**714016108013**		**DRAWING NO**	01
KANIMOZHI L	**714016108051**		**BATCH NO**	**A8**
KARTHICK RAJA P	**714016108054**		**MATERIAL**	PVC
ALL DIMENSIONS ARE IN mm			**QUANTITY**	2

Figure 3.5 2d view of coupling



PROJECT NAME	WATER TREATMENT BYMAGNETIC CONDITIONER			
STUDENT'S NAME	**REGISTER NO.**	**SCALE 1:1**	**PART NAME**	ELECTRO MAGNET
AMALA K PAUL	**714016108009**		**PART NO**	02
ANEESHA POORNIMA M	**714016108013**		**DRAWING NO**	02
KANIMOZHI L	**714016108051**		**BATCH NO**	**A8**
KARTHICK RAJA P	**714016108054**		**MATERIAL**	STEEL ALLOY
ALL DIMENSIONS ARE IN mm			**QUANTITY**	4

Figure 3.6 2d view of Electromagnet

3.2.3 PVC pipe

Two sets of pipes are used in fabrication of this magnetic water conditioner, a large one of 2.5 inch diameter(pipe2) and a small one of 2.0 inch diameter(pipe1). Both the pipes are connected together using a reducer. This is nothing but the common pipe used for irrigation by farmers and are easily available in the market.

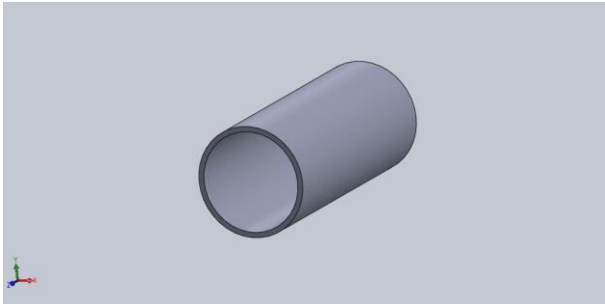
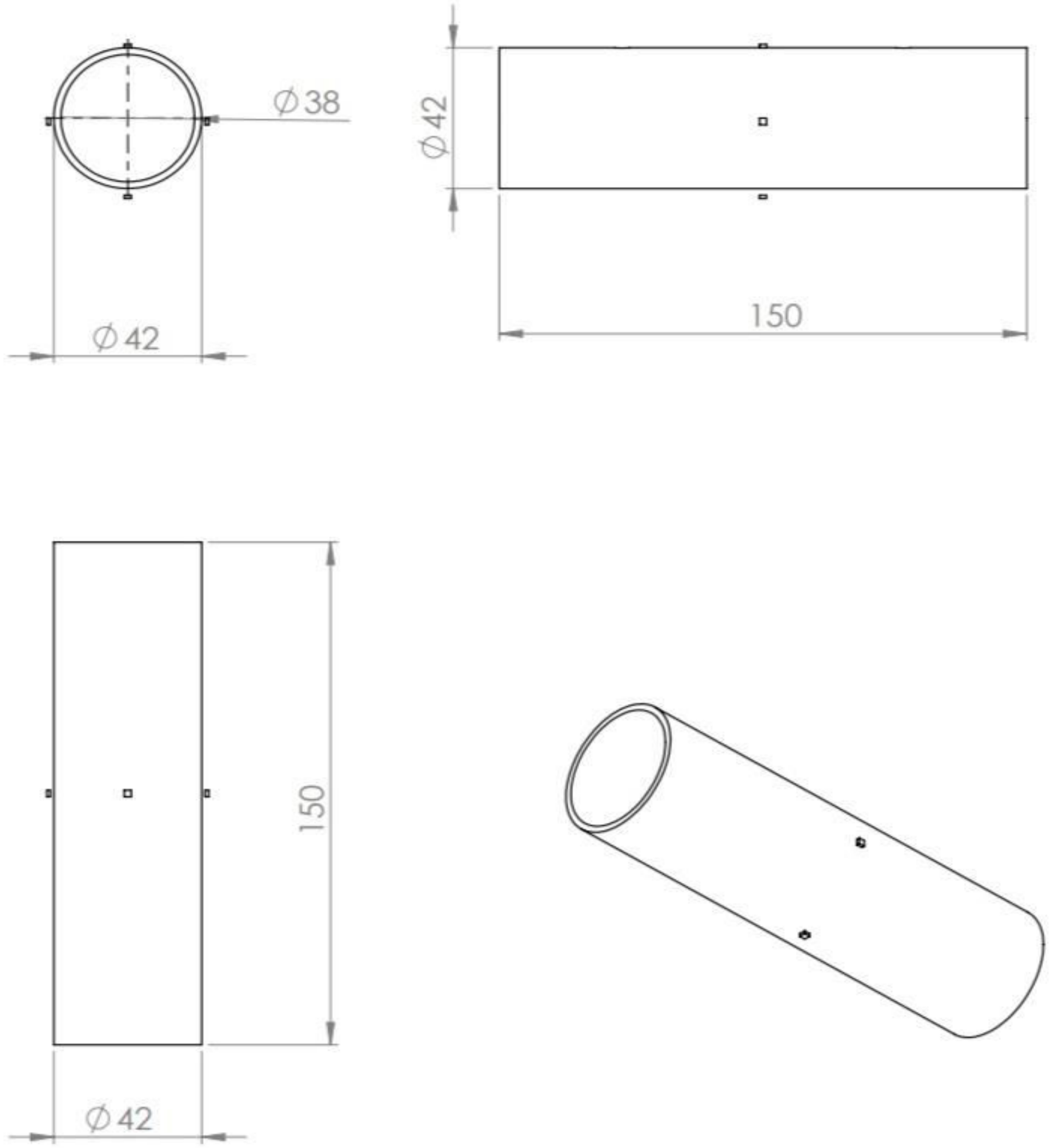


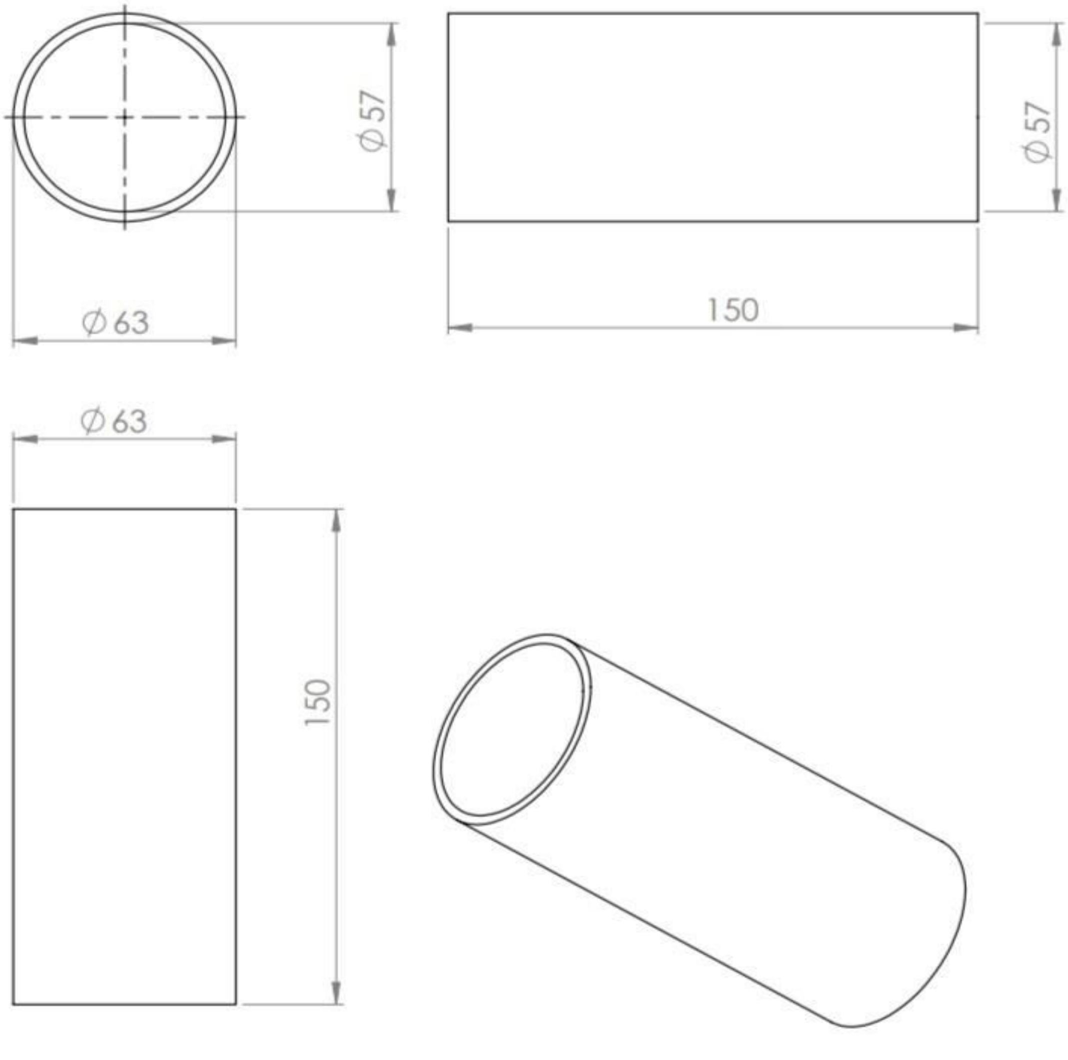
Figure 3.7 Pipe1

Figure 3.8 Pipe2



PROJECT NAME	WATER TREATMENT BYMAGNETIC CONDITIONER			
STUDENT'S NAME	REGISTER NO.	SCALE 1:1	PART NAME	PIPE
AMALA K PAUL	714016108009		PART NO	03
ANEESHA POORNIMA M	714016108013		DRAWING NO	03
KANIMOZHI L	714016108051		BATCH NO	A8
KARTHICK RAJA P	714016108054		MATERIAL	PVC
ALL DIMENSIONS ARE IN mm			QUANTITY	1

Figure 3.9 2d view of Pipe 1



PROJECT NAME	WATER TREATMENT BYMAGNETIC CONDITIONER			
STUDENT'S NAME	REGISTER NO.	SCALE 1:1	PART NAME	PIPE
AMALA K PAUL	714016108009		PART NO	04
ANEESHA POORNIMA M	714016108013		DRAWING NO	04
KANIMOZHI L	714016108051		BATCH NO	A8
KARTHICK RAJA P	714016108054		MATERIAL	PVC
ALL DIMENSIONS ARE IN mm			QUANTITY	1

Figure 3.10 2d view of Pipe 2

3.2.4 Ionization rod

It consists of a steel housing and a metal rod, which form a pair of electrodes. The rod gets consumed during the conditioning of water. The water from natural resources contain sufficient salts to provide necessary electrolyte to support the galvanic action between electrodes. As a result current flows between electrodes. Passage of this current causes electrolysis leading bto ionization.

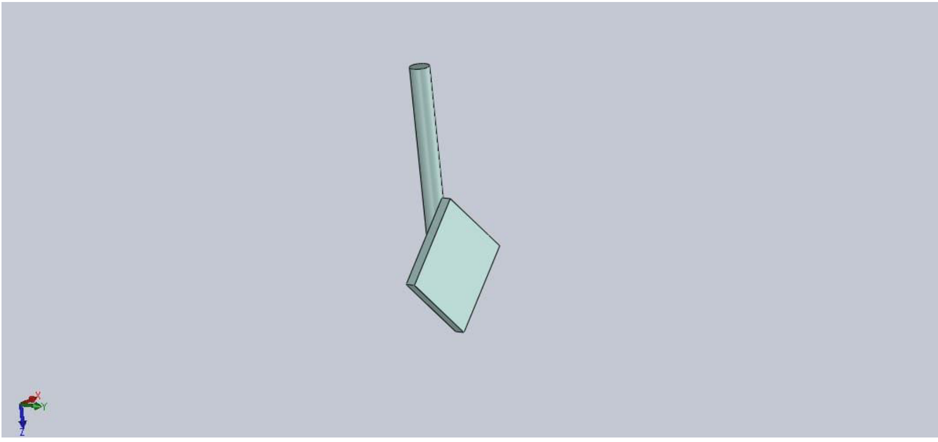
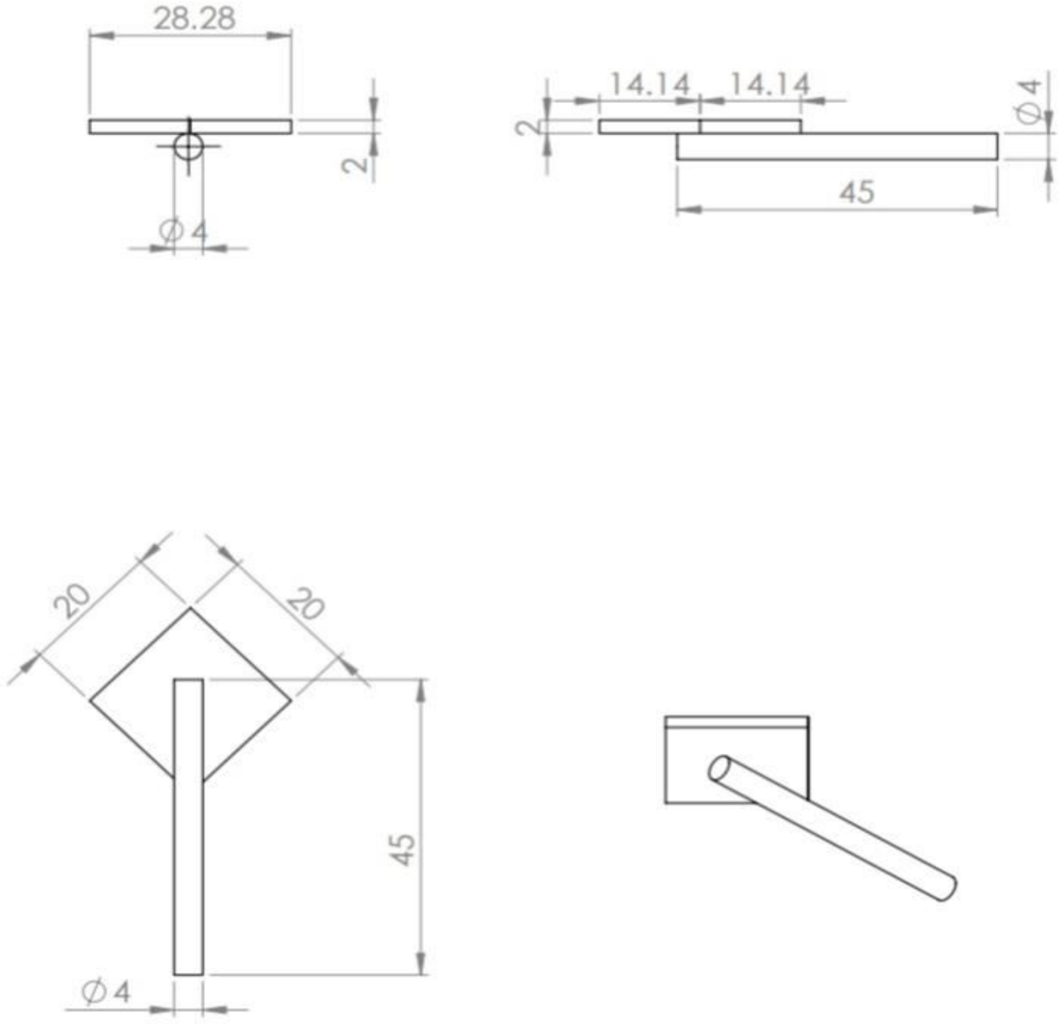
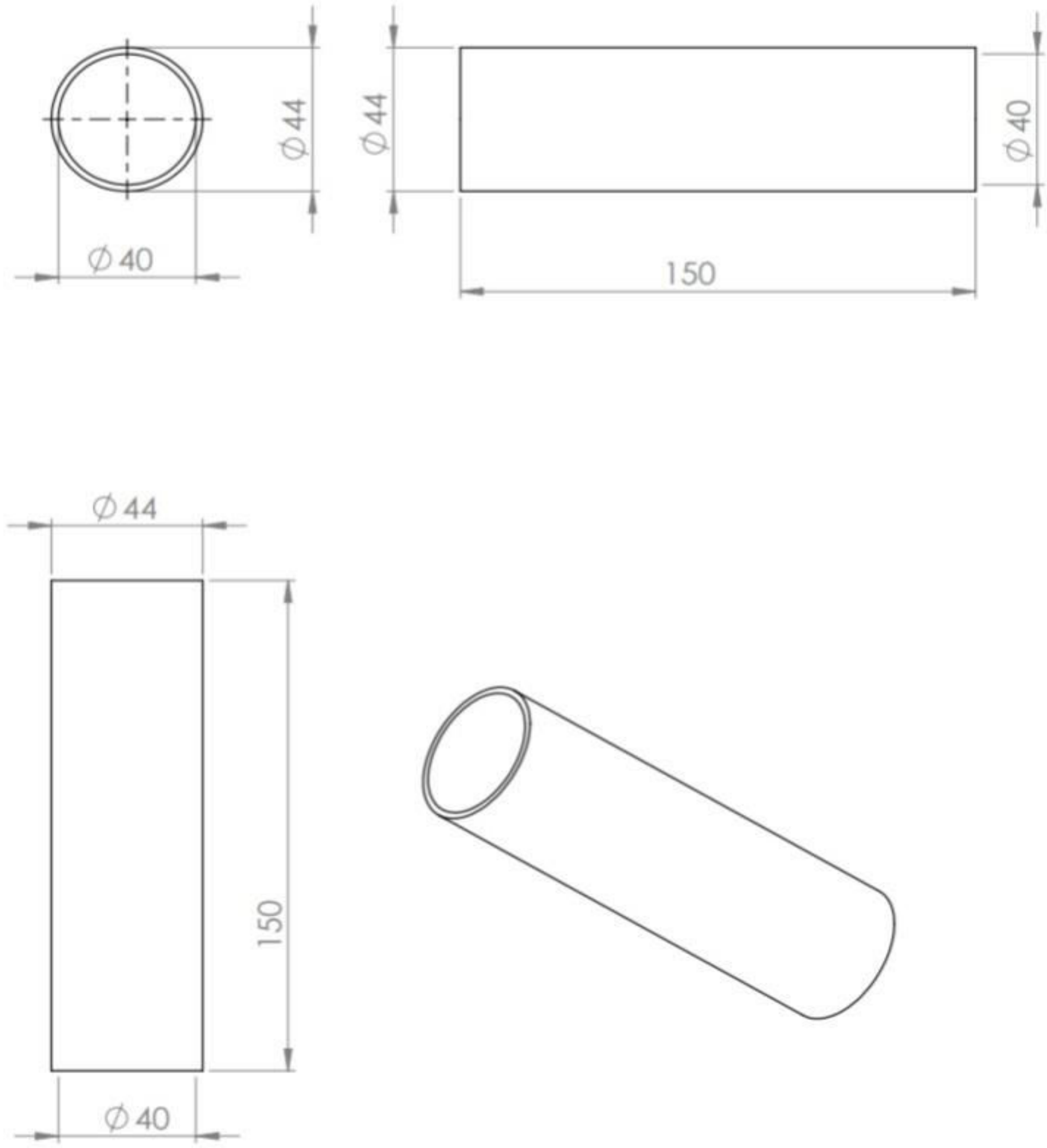


Figure 3.11 Ionization rod



PROJECT NAME	WATER TREATMENT BYMAGNETIC CONDITIONER			
STUDENT'S NAME	REGISTER NO.	SCALE 1:1	PART NAME	IONIZATION ROD
AMALA K PAUL	714016108009		PART NO	05
ANEESHA POORNIMA M	714016108013		DRAWING NO	05
KANIMOZHI L	714016108051		BATCH NO	A8
KARTHICK RAJA P	714016108054		MATERIAL	MILD STEEL
ALL DIMENSIONS ARE IN mm			QUANTITY	2

Figure 3.12 2d view of Ionization rod



PROJECT NAME	WATER TREATMENT BYMAGNETIC CONDITIONER			
STUDENT'S NAME	REGISTER NO.	SCALE 1:1	PART NAME	PIPE
AMALA K PAUL	714016108009		PART NO	06
ANEESHA POORNIMA M	714016108013		DRAWING NO	06
KANIMOZHI L	714016108051		BATCH NO	A8
KARTHICK RAJA P	714016108054		MATERIAL	PVC
ALL DIMENSIONS ARE IN mm			QUANTITY	1

Figure 3.13 2d view of Main pipe

3.2.5 Ferrite magnet

It plays the same role as that of the electromagnet and neodymium magnet. It helps in the ionization of water molecules at a higher rate.

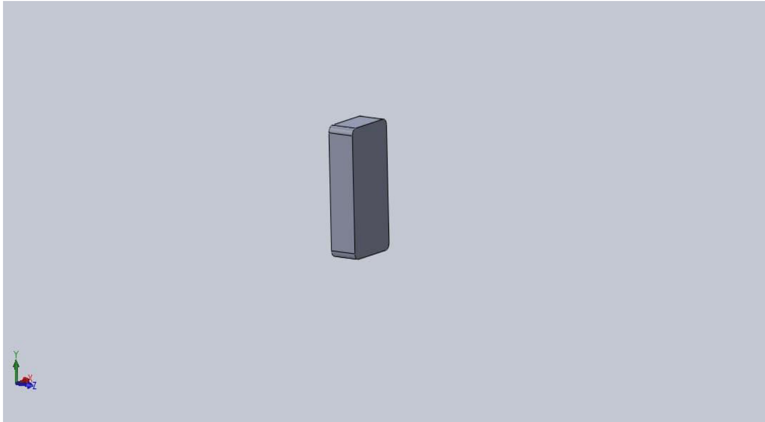


Figure 3.14 Ferrite magnet

3.2.6 Neodymium magnet

A neodymium magnet is used for the exact purpose as that of an electromagnet. It is used to cause ionization of water molecules by breaking the weak hydrogen bonding in water. The neodymium magnet will have a higher effect as compared to electromagnet so it is added alongwith it.

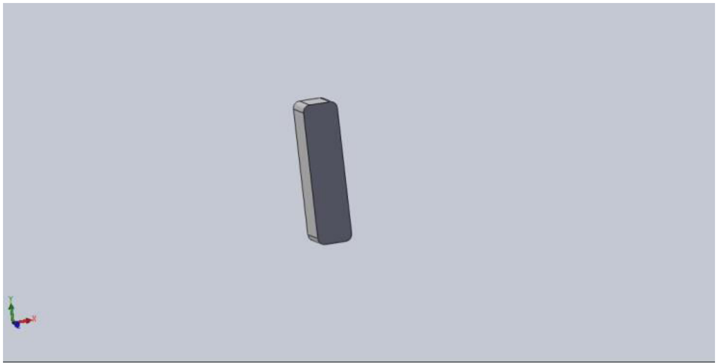
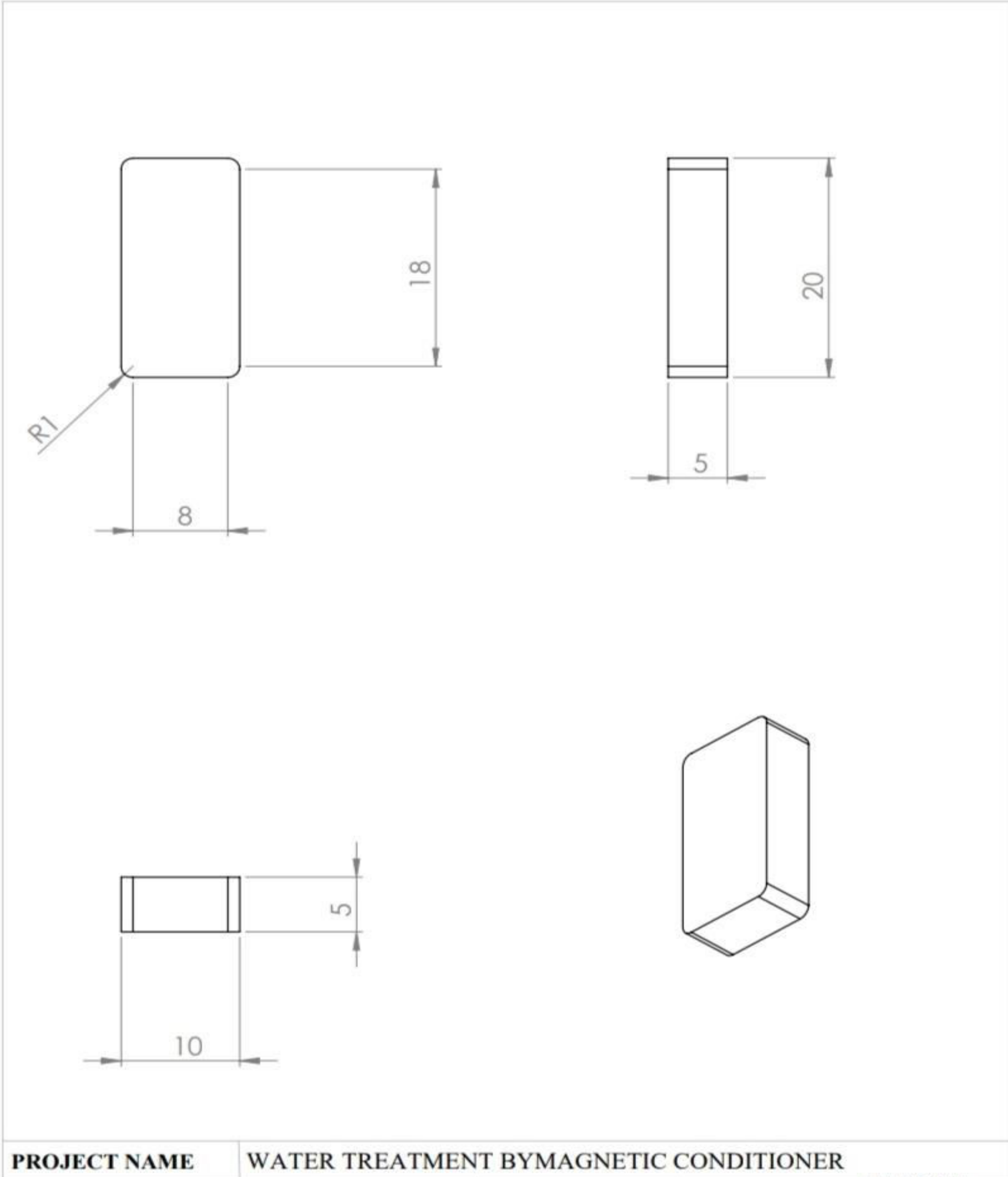
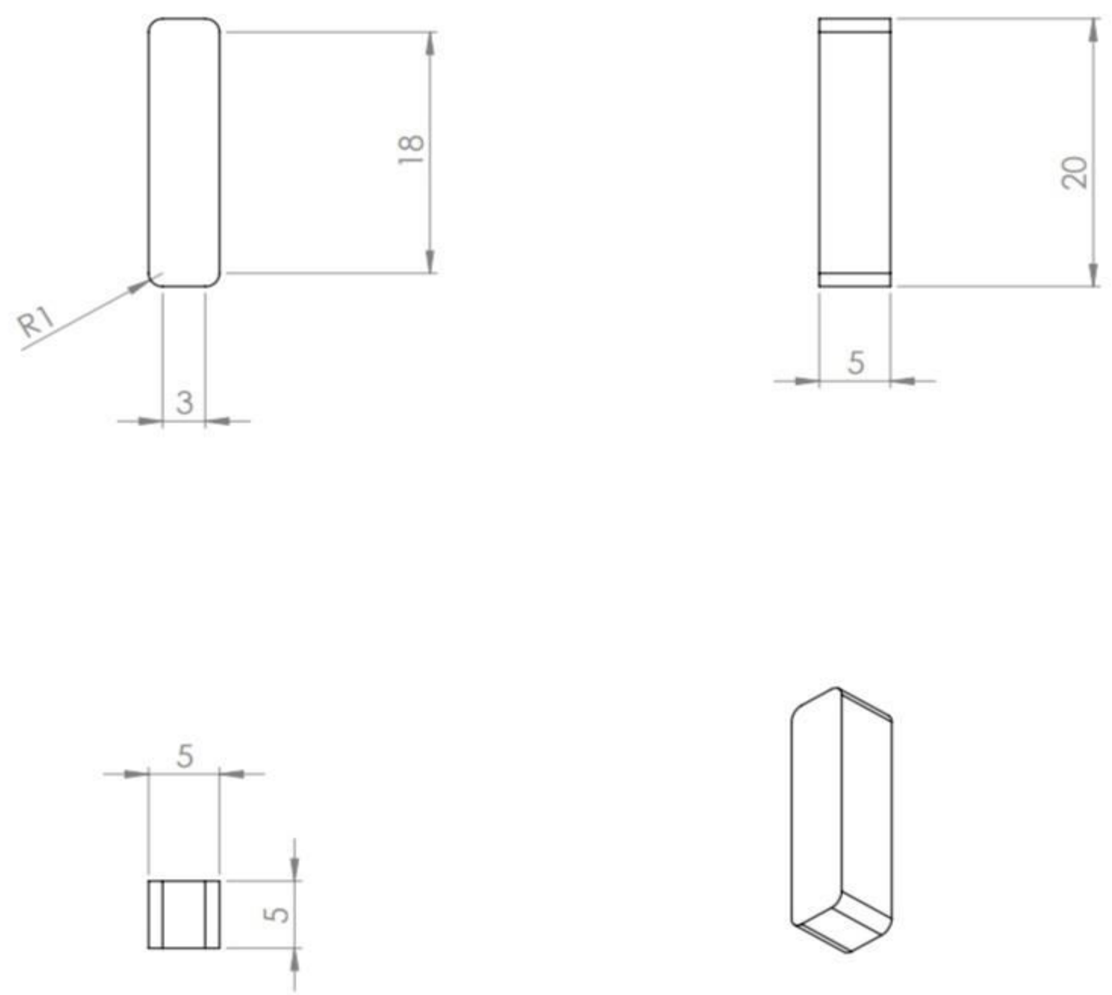


Figure 3.15 Neodymium magnet



PROJECT NAME	WATER TREATMENT BYMAGNETIC CONDITIONER			
STUDENT'S NAME	REGISTER NO.	SCALE 1:1	PART NAME	FERROUS MAGNET
AMALA K PAUL	714016108009		PART NO	07
ANEESHA POORNIMA M	714016108013		DRAWING NO	07
KANIMOZHI L	714016108051		BATCH NO	A8
KARTHICK RAJA P	714016108054		MATERIAL	MILD STEEL
ALL DIMENSIONS ARE IN mm			QUANTITY	8

Figure 3.16 2d view of Ferrite magnet



PROJECT NAME	WATER TREATMENT BYMAGNETIC CONDITIONER			
STUDENT'S NAME	REGISTER NO.	SCALE 1:1	PART NAME	NEODYMIUM MAGNET
AMALA K PAUL	714016108009		PART NO	08
ANEESHA POORNIMA M	714016108013		DRAWING NO	08
KANIMOZHI L	714016108051		BATCH NO	A8
KARTHICK RAJA P	714016108054		MATERIAL	MILD STEEL
ALL DIMENSIONS ARE IN mm			QUANTITY	8

Figure 3.17 2d view of Neodymium magnet

3.2.7 Reducer

A reducer is a type of pipe fitting that reduces the pipe size from a larger diameter to a smaller diameter. It allows for a change in pipe size to meet hydraulic flow requirements of the system anc to adapt to the existing piping of different size. In short it connects two pipes of different diameter.

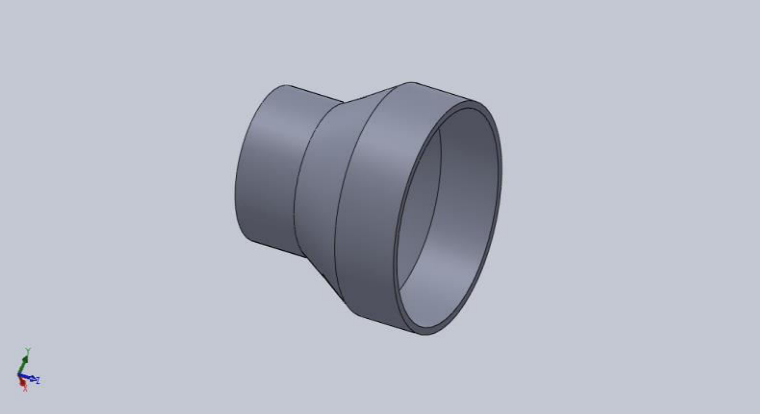


Figure 3.18 Reducer

3.3 Components and quantity

Table 3.1

S.No.	Components	Material	Nos.
1	Electromagnet	Copper-aluminium alloy	4
2	Pipe-2.5 inch	PVC	1
3	Pipe-2 inch	PVC	1
4	Coupling	Steel	2
5	Ionization rod	Plain carbon steel	2
6	Neodymium magnet	Neodymium	8
7	Ferrate magnet	Ferrrous iron	8

3.4 Working

The project "Water treatment by magnetic conditioner" is aimed at increasing the overall crop productivity by providing good quality irrigation water to the farmers. A comparative study among a student made electromagnetic conditioner, a magnetic conditioner available in the market(provided by Geo enviro solutions) as well as non treated water was made in a field with the cultivation of radish(Raphanus raphanistrum). Radish was chosen as it can be harvested in 45-50 days.

A land of size 24*6 was provided by the institution, which was then divided into six plots. These plots are cultivated and irrigated at random with non treated water, water treated with magnetic conditioner provided by the company and water treated with student made magnetic conditioner. The germination rate in each plot was observed and the weather parameters are recorded regularly.

Water from natural resources contain enough salts that can provide the electrolyctic medium for the ionization rod that has been attached on the machine. As the water flows through the machine ionization begins to take place due to the magnetic action of electromagnetic. This results in the cleavage of hydrogen bonding in water molecules leaving the ions free. Thus these ions can be easily absorbed by the plant roots.

3.5 Exploded view

The designed components are drafted to manufacture the components accurately. In this drafting the part design are detailed in required parameters with the help of the drafted parts only the manufacturers fabricate the components. So only the drafted design is also called fabrication design. Each manufacturing parts drafted, detail views and cut sections are given, wherever required.

3.6 CALCULATIONS

DISCHARGE OF PIPE

Internal pressure = 5 bar

Pipe diameter = 63mm

Density of water = 1000kg/m^3 Bernoulli's

formula = $(\rho v^2/2) + \rho gh + p = const$

$V = \sqrt{(p_i - p_a)2/\rho_w}$

$= \sqrt{(5\ bar - 1\ bar)2/1000(kgm^{-3})}$

= 28.284 m/s

Discharge(Q) = Av

$= (\pi r^2)v$

$= \pi * (0.32mm)^2 * 28.284m/s$

$= 0.08\ m^3/s$

= 15.0 6 l/min

SEED RATE CALCULATION

Area of the field = 24m*6m

$= 144m^2$

Length of single bed = 4m

Crop spacing = 1,5m

No.of seeds on a single bed

= 9*9

= 81

Total No.of beds = 6

Total No.of seeds = 81*6

= 486

For effectiveness 3seeds are planted on a single hole

Then seed rate will be = 486*3

= 1458

Efficiency of Germination

Effeciency = <u>seeds germinated * 100</u>

Seeds sown

Seeds sown in each plot = 81

I. Seeds germinated in plot1 = 68

Effeciency of plot1 = 83%

II. Seeds germinated in plot2 = 72

Effeciency of plot2 = 88%

III. Seeds germinated in plot3 = 76

Effeciency of plot3 = 93%

IV. Seeds germinated in plot4 = 71

Effeciency of plot4 = 87%

V. Seeds germinated in plot5 = 63

Effeciency of plot5 = 77%

VI. Seeds germinated in plot1 = 77

Effeciency of plot1 = 96%

CHAPTER IV

RESULTS AND DISCUSSION

Magnetic conditioner was designed and fabricated as explained in sub-chapters 3.1 to 3.8. Overall specification with cost estimation of fabricated Magnetic conditioner is dealt in this chapter.

Magnetic Conditioner

The work study of the components for which the Magnetic conditioner are planned to be fabricated mainly involves the method study and the time study for the components. The fabricated prototype of conceptual design is shown in Fig. below.

Method study

The method study of the components for the Magnetic conditioner are studied in detail. The method study mainly involves the different operations involved in the fabrication and the sequence of its operation.

Fabrication process

The material selected must possess the necessary properties for the proposed application. The various requirements to be satisfied can be weight, pressure, friction, ability to withstand environmental attack from chemicals, service life, reliability etc.

The following four types of principle properties of materials decisively affect their selection.

i. Physical
ii. Mechanical
iii. From manufacturing point of view

4.1 Prototype

Fig.4.1 Fabricated prototype

The various physical properties concerned are TDS, EC, PH, N, P, K, Na, Hardness, DO, BOD, COD.

The various Mechanical properties Concerned are pressure, shear, force, friction, velocity and volume of water, soil erodiblity properties.

Manufacturing of prototype

Sometimes the demand for lowest possible manufacturing cost or component qualities obtainable by the application of suitable coating substances may demand the use of special materials.

Quality required

This generally affects the manufacturing process and ultimately the material. For example, it would never be desirable to go casting of a smaller number of components which can be fabricated much more economically by welding or hand forging the steel and the pipe.

Availability of materials

Some materials may be scarce or in short supply, it then becomes obligatory for the designer to use some other material which though may not be a perfect substitute for the material designed. The delivery of materials and the delivery date of product should also be kept in mind.

Space consideration

Sometimes high strength materials have to be selected because the forces involved are high and space limitations are there.

Sequence of operation

The irrigation operation has to undergo steps in the below given sequential order.

- *i.* Opening of valve
- *ii.* Switching on Electromagnet
- *iii.* Connecting of pvc pipes
- *iv.* Adjusting the water flow
- *v.* Directing the pipes into the field
- *vi.* Noting down the duration of water flow per plot
- *vii.* Further irrigation
- *viii.* Final

Time study

The time taken for each irrigation operation into the field is sorted out and given in the table 4.1.

Table 4.1 Time study

Operations	Cycle time (min)
1^{st} plot	13
2^{nd} plot	11
3^{rd} plot	13
4^{th} plot	11
5^{th} plot	12
6^{th} plot	10

The time study for the different operations involved in the irrigation operation are studied and noted down using the stop watch in the time study.The time taken for each operation

Is evaluated individually after the irrigation period.

The variation of crop growth after usage of magnetic conditioner is positive, enhancing the productivity. Hence implimenting magnetic conditioner is sensible and has has good effectiveness.

Inorder to meet the demand the optimum irrigation operation that can be altered is irrigation operation.The fabricated prototype of magnetic conditioner is given below in fig.

Table 4.2 Specification of prototype

Specification	Values
Overall length	30 cm
Overall breadth	6.5 cm
Overall height	15 cm
Overall weight	10 Kg
Material	Mild steel

Cost estimation

It includes the cost of frame, motor, pvc pipe, electromagnet, neodymium magnet, ferrite magnet, valves and reducer. The cost of the individual components that had used in the development of the prototype had been listed below in Table 4.3.

4.2 Production cost

The materials and components used for fabrication of pellets are listed in table 4.1.

Table 4.3 Production cost

S.No.	Materials and components	Cost
1	Activated Carbon	300
2	Araldite	250
3	coupler	450
4	Ferrite magnet	2500
5	Frame	2500
6	Motor	3500
7	Neodymium magnet	2500
8	Painting cost	250
9	PVC pipe	400
10	Reducer	200
11	Teflon tape	150
12	Transportation charge	375
13	Valve	170
14	Welding cost	500
15	Working of labour charge	1235
	TOTAL	**15700**

4.3 Fixed cost

1) Depreciation = (P – S) / L

= (15700 – 785) / 5

= 2983

P – purchase price {15700}

S – salvage value (5% of P) {785}

L – life in years {5 years}

2) Taxes (2%)

= (P + S) / 2 × 1/100

= (15700 + 785) / 2 × 1/100

= 82

4.4 Variable cost

4) Electricity cost

Electricity cost for 1 day = Power utilized for 1 day × Cost of 1 kwh

Power = HP × 746

= 1× 746

= 746 watts

Power utilized for 1 day = (watt×hour)/1000

= (746×8)/1000

= 5.96 kwh

Cost of one kwh of electricity = 4

Electricity cost for 1 day = Power utilized for 1 day × cost of 1 kwh

= 5.96 × 4

= 23.84/day

Electricity cost per month = Electricity cost for 1 day × 30

= 23.84× 30

= 715.2/month

= 2.9/hr

5) Wages

For one labour = 12000/month

= 50/ hour

6) Repair and maintenance

Repairs (12 %)

Amount spent for repairs = 15700 × 12/100

= 1884

Maintenance

As the magnetic conditioner works with 100% efficiency and highly reliable, there is no maintanence cost.

4.5 Performance test

1) Efficiency = $\left(\dfrac{\text{no.of seeds germinated}}{\text{No.of seeds sown}} \times 100\% \right)$

No.of seeds sown = 1458

No.of seeds germinated = 1200

Efficiency = 82%

2)% loss of seed = $\dfrac{\text{(seeds sown – seeds germinated)}}{\text{(seeds sown)}} * 100$

No.of seeds sown = 1458

No.of seeds germinated = 1200

% Loss of seed = 17%

4.6 Testing

The first and foremost important test that is to be tested is the quality of water.The water quality should be in such optimum condition as it plays a vital role in increasing the crop productivity.The various tests procedures of water quality tests is mentioned below.

General procedure for conducting tests

SELECTION OF PARAMETERS
↓
SELECTION OF METHODS
↓
PRECISION AND ACCURACY OF METHOD
↓
SELECTED AS PER REQUIREMENT
↓
PROPER SAMPLING
↓
PROPER LABELING
↓
PRESERVATION
↓
ANALYSIS
↓
REPORTING

Selection of Methods

The methods of water quality analysis are selected according to the requirement.

The factors playing key role for the selection of methods are:

(i) Volume and number of sample to be analysed

(ii) Cost of analysis

(iii) Precision required

(iv) Promptness of the analysis as required

4.6.1 Testing of DO

Procedure

- Collect sample in BOD bottle
- 2 ml $MnSO_4$+ 2 ml Alkali iodide-azide+close stopper
- Mix well + allow the ppt to settle
- Add 2 ml concentrated H_2SO_4 + mix well till ppt dissolves
- Take 203 ml (Correspond to 200 ml) sample in a conical
    - flask+titrate against Sodium thiosulphate (0.025 N) till pale
    - yellow colour + starch + titrate till blue to colourless

Calculation

- 1 ml of 0.025N $Na_2S_2O_3$ = 0.2 mg of O_2
- D.O. in mg/l =(0.2 x 1000) x ml of thiosulphate
    - 200

4.6.2 Testing of BOD

Procedure

Preparation of dilution water

- Aerate the required volume of D.W. by bubbling compressed air for 1-2 days
- Add 1 ml each per litre of dilution water Phosphate buffer Magnesium sulphate Calcium chloride Ferric chloride
- Mix well
- In case, waste not expected sufficient bacterial population, add seed (2 ml settle sewage / litre of dilution water)
- Determination of D.O.
    - Samples and ii) Blank, on initial and after 5 days
- 2 ml $MnSO_4$ + 2 ml Alkali-iodide-azide+stopper immediately

- Mix well + allow the ppt. to settle
- Add 2 ml concentrated H2 SO4 + mix well till ppt. dissolve
- Take 203 ml (correspond to 200 ml) sample in a conical flask
- Titrate against sodium thiosulphate (0.025 N) till pale yellow colour + starch solution + blue colour + titrate till colourless

4.6.3 Testing of ph

- Fill 1 test tube with sample water to the level to thr level of the line marked (5ml).
- Carefully add 10 drops of the wide range indicator to the test tube.
- Cap the test tube with small blue plastic cap and shake the solution gently until the color is uniform.
- Select the appropriate oclet comparator and insert the test tube into thr appropriate slot

4.6.4 Testing of TDS

- Pour some water sample into the 250 beaker or a cup to a level of 1 or 2 cm.
- Push the white button on the digital tester to turn it on.When it is on ,it will read 000μs.
- Put the tip of the digital TDS tester into the sample water.
- Multiply the meter reading by 5.
- Push the white button to turn the meter off and wash the meters electrodes.

In the same manner N ,P ,K ,EC ,Hardness are tested by using either titration method or by using meters.

Table 4.4 Water Quality Test

Parameters	**W_1**	**W_2**	**W_3**
pH	7.02	7.02	6.65
EC	6.77 µS	2.55 µS	2.45 µS
TDS	4360 ppm	2180 ppm	1.70 ppm
NITRATE(N)	256 ppm	244 ppm	207 ppm
POSPHATE(P)	2.2 ppm	2.08 ppm	2.01 ppm
POTASH(K)	0.02 ppm	0.02 ppm	0.02 ppm
SODIUM(Na)	0.52 ppm	0.5 ppm	0.5 ppm
HARDNESS	72 ppm	86 ppm	83 ppm
DO	6.5 mg/l	7.1 mg/l	7.2 mg/l
BOD	3.5 mg/l	4.2 mg/l	4.6 mg/l
COD	240 mg/l	247 mg/l	251 mg/l

W_1 **=** NORMAL WATER

W_2 **=** TREATED WATER (STUDENT'S)

W_3 **=** TREATED WATER (INDUSTRY)

4.6.5 Testing of moisture content in soil

Neutron moisture meter

Soil moisture can be estimated quickly and continuously with neutron moisture meter without disturbing the soil. Another advantage is that soil moisture can be estimated from large volume of soil. This meter scans the soil about 15 cm diameters around the neutron probe in wet soil and 50 cm in dry soil. It consists of a probe and a scalar or rate meter. This contains a fast neutron source which may be a mixture of radium and beryllium or americium and beryllium. Access tubes are aluminum tubes of 50-100 cm length and are placed in the field when the moisture has to be estimated. Neutron probe is lowered in to access tube to a desired depth. Fast neutrons are released from the probe which scatters in to soil. When the neutrons encounter nuclei of hydrogen atoms of water, their speed is reduced. The scalar or the rate meter counts of slow neutrons which are directly proportional to water molecule. Moisture content of the soil can be known from the calibration curve with count of slow neutrons.

Table 4.5 Moisture Content(%)

No.of Irrigation	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6
1	40	43	47	41	46	50
2	49	48	50	51	47	49
3	51	49	51	48	55	53
4	48	53	49	55	51	48
5	51	54	48	50	53	51

4.6.6 Measurement of radish leaf and tuber

For measuring radish leaf parameters two radish plants are selected from each plot and leaf's length and its width are measured using a measuring tape.

Table 4.6 Measurement of leaf

Plot	Leaf length(cm)		Leaf width(cm)	
	Sample 1	Sample 2	Sample 1	Sample 2
1	22.86	25.4	10.16	7.62
2	17.8	20.32	5.08	7.58
3	17.81	15.24	6.35	7.6
4	17.5	15.21	6.24	7.59
5	17.65	16.55	7.62	8.89
6	12.7	17.8	7.68	8.76

For measuring radish tuber parameters two radish plants are selected from each plot and tuber's length&diameter measured using a measuring tape.Tubers weight is measured using weighing guage.

Table 4.7 Measurement of tuber

Plot	Tuber length(cm)		Tuber width(cm)		Tuber weight(g)	
	Sample 1	Sample 2	Sample 1	Sample 2	Sample 1	Sample 2
1	13.14	15.4	3.16	3.62	42.44	86.28
2	15.42	18.32	5.08	4.58	68.90	55.67
3	17.22	19.24	4.35	3.62	73.39	69.55
4	17.3	16.21	3.24	3.5	81.14	63.59
5	16.5	15.55	3.62	4.92	76.31	83.24
6	14.36	17.7	4.68	3.76	88.48	71.15

CHAPTER V
SUMMARY

For a healthy and disease free environment, the food we consume should be organic. Theheavy usage of fertilizers is affecting the quality of the food we eat. But due to increased land degradation farmers have to depend on chemical fertilizers to have better yield. Here comes the need of an innovation that provides maximum yield from field with minimum production cost, which is still organic and healthy.

5.1 Summary

Our project is a great boonto the farmers.All the parts and components used in the project were designed and analyzed with the help of solid works 2018. Each part was initially designed separately and then assembled into a single component. The correct material was chosen and selected once the design and analysis of the design was over.

5.2 Achievement of the objective

The main objective of this project was to study the effect of simple permanent magnets and electromagnets on crop growth. The prototype was developed in such a way that it can be easily attached in the irrigation pipeline. The result shown that the crop yield was maximum from the field irrigated with magnetic conditioner available in the market compared to non treated water. If developed in a large scale unit, it will reduce overall input cost for farming.

5.3 Benefits of this project

Water treatment by magnetic conditioner helpsfarmers to obtain maximum crop productivity with minimum usage of water. It saves a lot of fertilizers and more chemical free yield can be obtained. The overall production cost can be minimized since there us less rely on chemicals.

5.4 Learning from the project

i. Design and development of prototype.
ii. Field study of many agricultural equipments and tools.
iii. Dealing with associates and proper communication.
iv. Teamwork, time management, discipline.

This project was a great opportunity for us as agriculture engineers to study about various problems faced by farmers, their needs and with our limited knowledge how can we resolve them. We gained a lot of practical knowledge regarding assembling, planning and farm operations. We feel that our project will be a boon to farmers and will also be a bridge between agriculture and innovation.

We are proud that we have completed our project successfully in short time.

5.5 Conclusions

Water treatment by magnetic conditioner' was an innovative project that targets on increasing the crop yield by using basic electromagnetic principles on irrigation water. The key objective of the project was to carry out irrigation and then study the effect of electromagnets and permanent magnets in the growth rate of crops as well as the crop yield.

A field of size 24*6 was provided by the institution. It was then divided into 6 plots, all 6 being cultivated with the same crop(radish),but irrigated with three different water alternatively. A comparative study was made among a student made electromagnetic conditioner, a magnetic conditioner available in the market (provided by Geo Enviro solutions) and non treated water.

Many visible changes were noted even at the early stages of crop growth like the germination rate, number of healthy saplings etc..

The harvest was made after 45 days of sowing. The radish yield came to maximum from the plots treated with magnetic conditioner provided by Geo Enviro solutions, followed by student made electromagnetic conditioner. The least yield was obtained from plots irrigated with normal water.

Thus through this project we could conclude that when normal water gets magnetised using simple permanent magnet or electromagnet and then if used for irrigation it can improve the productivity with the least consumption of chemicals, fertilisersand minimal usage of water.

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