نادي الموهبة والابتكار
Talent and Innovation club

المؤسسة العامة للتدريب التقني والمهني
Technical and Vocational Training Corporation
الكلية التقنية بجدة

Clay Air Conditioning(CAC)

1

Index

the introduction

بسم الله الرحمن الرحيم

بسم الله الواحد الاحد، الفرد الصمد، الحمد لله حمدا كثيرا، والصلاة والسلام على رسوله

And after:

Global warming is one of the most serious environmental problems in the world and the reason for the rise in temperature. Therefore, cooling devices are widely available due to the importance of cooling and improving the atmosphere. However, the problem is the high costs of cooling devices that cause economic damage. Therefore, we need to provide cooling devices at the lowest costs, with the least electricity consumption, and ease of maintenance and operation. This is where our idea began, which is :

(Clay air conditioner) The project idea is based on inventing an air conditioning device that saves electricity and high quality cooling .

The team used innovative methods to reduce the loss of cold and maintain it for as long as possible before the Freon compressor starts working again for cooling.

This report explains what the project idea is, what it is based on, how you can implement this project at the lowest possible cost, what are the most prominent problems we faced and solved, and how we created model solutions and creative ideas with the help of the work team.

Project idea

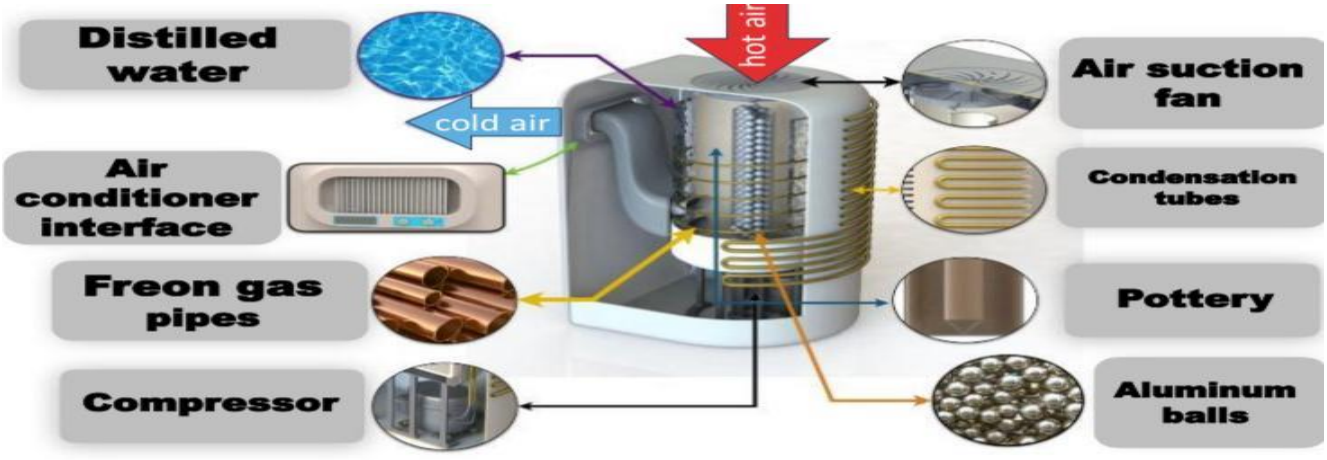
It reduces electricity consumption with minimal means, and here the Clay's ability to cool the atmosphere has been exploited.

The innovative part is the aluminum balls inside the hollow clay cylinder which gives longer stopping time.

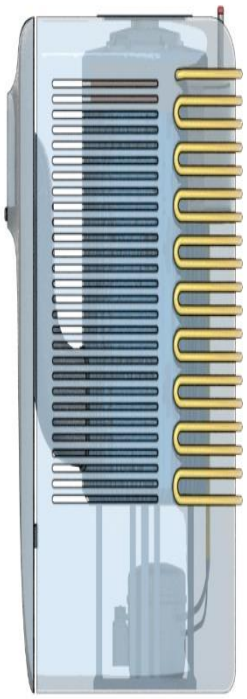
Compressor for cooling water meaning (energy saving):

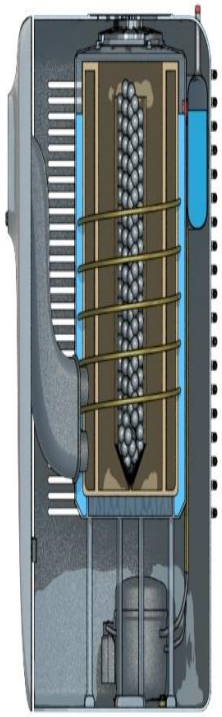
- The presence of water between the Clay and the external body surrounding the Clay helps to cool the air inside the Clay.
- The presence of aluminum balls inside the Clay to increase cooling and the properties of aluminum were used to maintain the cold and the speed of cooling of aluminum
- Clay has properties that can cool water, which helps cool air, and helps cool aluminum.
- Air conditioner interface and control keys with a screen under the air outlet area to know the information about cooling and controlling the reduction and flow of air and air cooling.
- There is a tube to transfer the Freon from inside the water for cooling.
- (Evaporator) and (coils responsible for heat exchangers or what is called heat exchanger, which is an exchange device heat exchange between two or more fluids at different temperatures, so it is also called a heat exchanger.

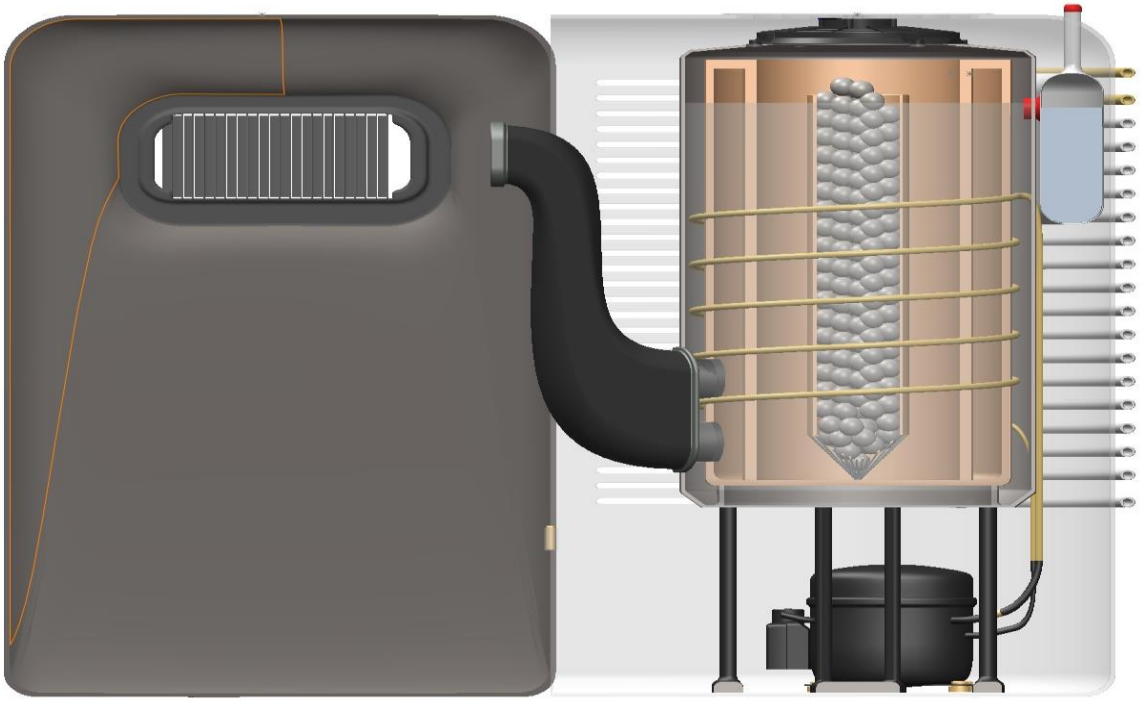
-

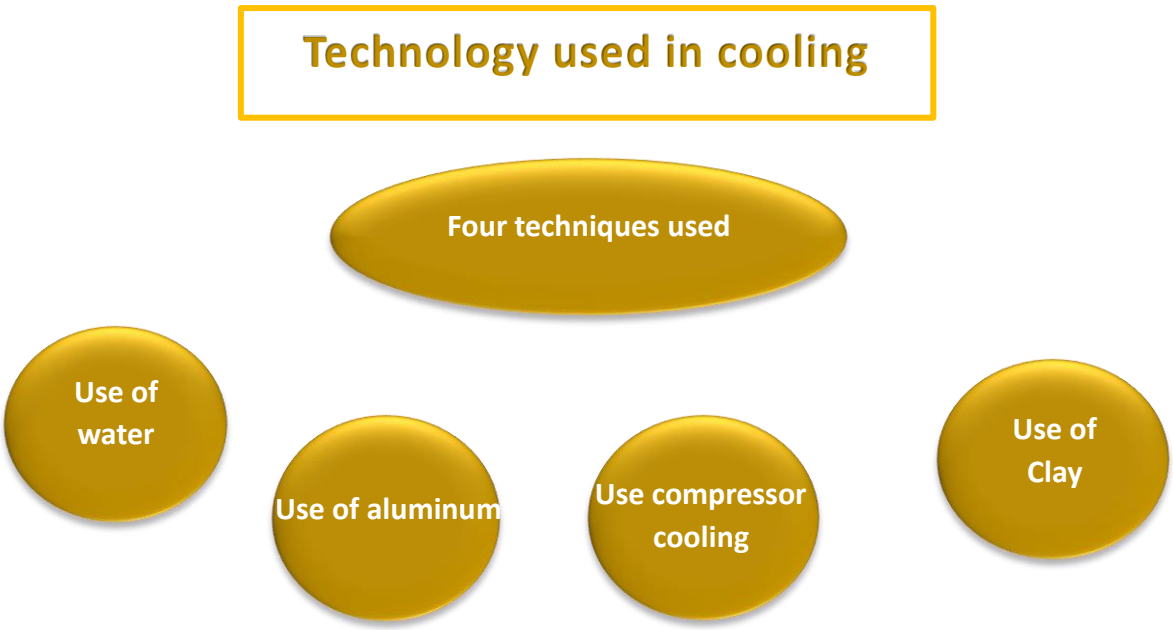


Model









1. Clay:

Clay is a type of material made from molded and dried mud that is then fired in kilns. Clay's properties include the following:

1. **Porosity**: Clay is porous, allowing for air and moisture exchange, making it an excellent choice for cooling applications.

2. **Strength**: Clay is strong and durable.

3. **Salt Absorption**: Clay absorbs and filters salts from water, which poses a disadvantage for our project. This issue has been addressed by using distilled water to prevent salt buildup on the clay surface.

4. **Environmentally Friendly**: Clay is biodegradable and eco-friendly, making it a sustainable and environmentally friendly option.

2. Compressor Cooling:

A compressor is a mechanical device containing pistons and valves, which works to collect and compress air into a tank by reducing its volume. The main component of compressed air is freon, and the primary advantages of the air conditioner compressor include:

1- **Enhanced Cooling Performance**: The air conditioning compressor is a device that circulates the refrigerant through the AC system, making it an essential component, and the compressor, located within the condenser unit, is responsible for compressing the refrigerant vapor.
2- **Compressor Protection**: Compressor spacers help reduce the compressor's temperature, preventing overheating that could potentially damage the compressor.
3- **Reduced Energy Consumption**: Due to the compressor, air conditioner spacers can help lower the system's electrical energy consumption..

3. Aluminum:

Aluminum has several properties that make it useful for applications involving heat transfer and cooling. These properties include:

1. **High Cooling Conductivity**: Aluminum has excellent cooling conductivity, Which means it can effectively transfer cold from the cooling source to the area that needs cooling.
2. **Lightweight**: Aluminum is lighter than many other materials used in cooling applications, making it easy to use in devices that require a light weight.
3. **Corrosion Resistance**: Aluminum has good corrosion resistance, allowing it to perform well in humid or corrosive environments without degrading.
4. **Ease of Forming**: Aluminum can be easily shaped into various forms, enabling the design of complex or customized parts for efficient cooling applications.
5. **Recyclability**: Aluminum is highly recyclable, making it an environmentally friendly choice for cooling and air conditioning applications

4. Water:

Water has unique properties that make it an ideal substance for cooling processes. These properties include:

1. **Easy Availability**: Water is a readily available natural resource, making it a cost-effective choice for use in cooling systems.

2. **High Thermal Conductivity**: Water has a high capacity for heat transfer, allowing it to cool surfaces efficiently and quickly.

3. **Environmental Friendliness**: Water can be used as an eco-friendly cooling medium, especially when used correctly without harmful chemical additives.

4. **Controllability**: The temperature and quantity of water can be easily regulated, allowing for customized cooling processes to meet specific application needs.

Steps to start the project

1-Brainstorming:

We held a meeting to generate new creative ideas and innovative solutions to deduce and identify possible problems so that we can overcome them and research and examine how we can create a new idea to provide solutions to the temperature in some very hot areas with the simplest means. We reached an initial model for cooling through Clay, which is a more effective model and closer to the real model. An approximate shape of the initial project was drawn, and then the components and numbers required to implement the initial model were determined, and then the tasks were divided among the members of the work team, each depending on his specialization and what he can help with in any part of preparing, installing and equipping the project.

2-Distribution of tasks:

1- Engineer Hassan Al-Aidaroos supervising, auditing, following up and
2- directing.
3- Trainee Salah Hassan, specialist in digital control electrical.
4- Trainee Youssef Al-Aidaroos, who specializes in 3D printers
5- Trainee Muhammad Al-Dubaie, who specializes in refrigeration.

2-List the required parts

1- Wooden board.
2-Iron sheet.
3- Compressor
4-Copper tube for transporting freon.
5-This is a temperature gauge.
6-AC to DC converter.
7-Evaporator and condenser coils.
8-screws
9-Electrical wires.
10- Electric switches.
11- Illuminations.
12- Electric bag.
13- 3D printed cylinders
14 - Fan.
15- Thermostat.
16 - Aluminum balls.
17- Clay

4- Implementation:

We collected the parts required to implement the project, counted them, took the required measurements, and started working on sanding the wooden board and cutting the iron sheet and shaping it according to the required shapes installing the copper tube with the compressor and evaporator and making a plastic cylinder using 3D printers connecting the electrical components to completion and running the initial experiment.
The process was completed successfully, thank God, after the initial trial and then completing all parts.

5- The problems faced.

- In the case of designing and manufacturing the plastic cylinder, some technical problems occurred in the printing device 3D, including a blockage in the plastic pumping tube, which caused the machine to stop before it finished making the required shape, which made us divide the design into three Parts and assembly.

- Also, when operating, we had a problem with the compressor, which caused it to reach a temperature of high temperature due to a technical problem in the thermostat and then this problem was solved by calibration thermostat.

Project tools

Clay

Claywas used in this project due to its unique properties in retaining coolness and its ability to provide cooling in a time before refrigerators were invented. This Clay works on the principle of evaporation With continuous and moving air flow, which helps cool the water. Since the Clay vessel is porous, it gradually cools the water and absorbs its heat-a property not found in any other material. Clay, pot is porous, it

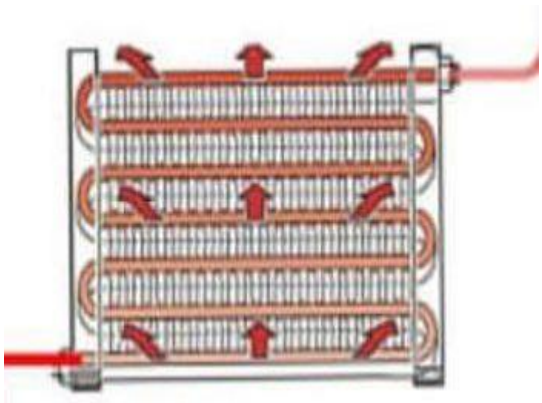
Aluminum

The thermal conductivity of aluminum is three times higher than that of steel, making aluminum an important material for cooling applications, as it can absorb and retain coolness for longer periods. Additionally, being non-toxic, aluminum is widely used in cooling systems.

Compressor

The compressor, or "compressor unit," is the primary power source for the air conditioning system. It functions as a pump that circulates Freon gas throughout the air conditioner's components and systems. The compressor supplies gas to facilitate the cooling process, then distributes it to the rest of the air conditioning components, making it one of the most critical parts of the system. One sign of compressor failure is the air conditioner stopping entirely, which significantly impacts the cooling process

Condenser coils



This is the condenser, used for heat dissipation. Condensers are one of the main channels for transferring heat in cooling systems. During operation, the condenser dissipates heat from the high-pressure, high-temperature refrigerant gas delivered by the compresso

Copper tube

The concept of extending the copper tubing for an air conditioner involves installing a set of pipes to connect the indoor and outdoor units, allowing the refrigerant to flow freely between them. These pipes are extremely durable and resistant to corrosion, making them an ideal choice for long-term use in air conditioning systems.

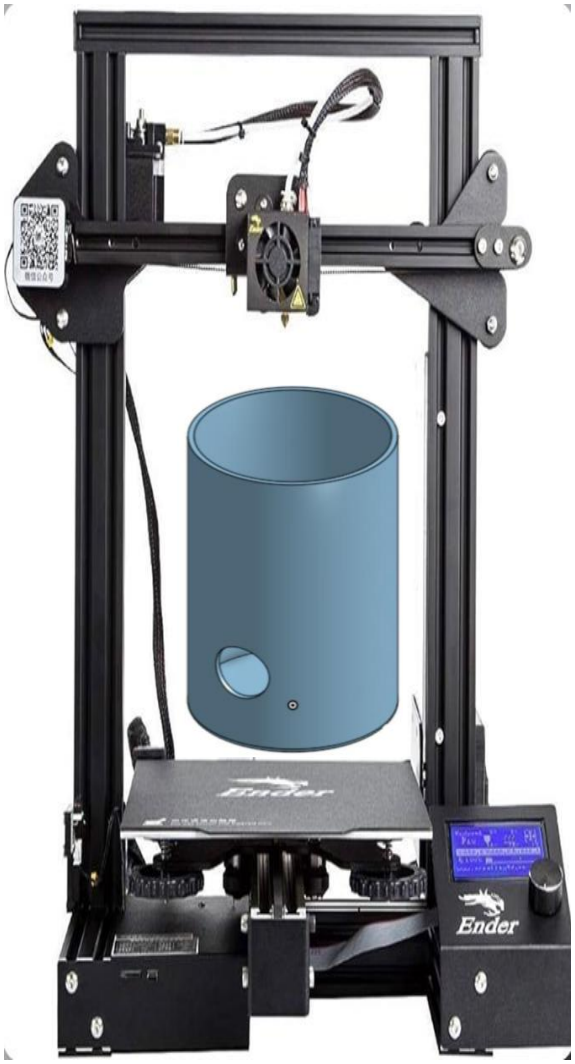
fan

"A cooling fan provides a refreshing and cool airflow that aids in cooling and energy efficiency. Some fans are designed to be more energy-efficient compared to others, making them a good choice for reducing electricity consumption

Converter

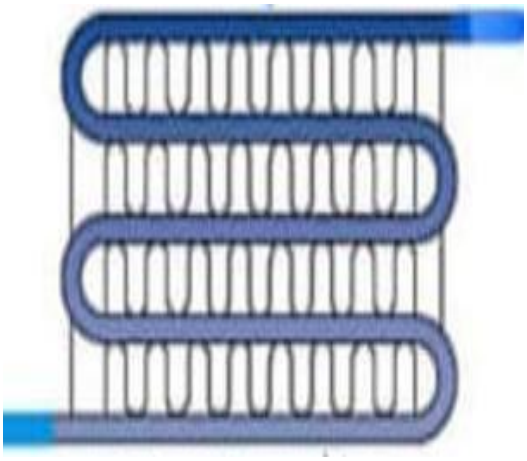
"The device that converts alternating current (AC) to direct current (DC) is called a rectifier. In some sources, it is also referred to as a converter. The process of converting AC to DC is an important method that is required in many applications that operate on a DC power source. This conversion can be achieved using only a few electronic components.

D3 printer



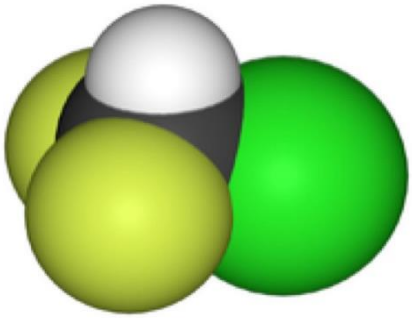
It is one of the manufacturing techniques where parts are produced by dividing their 3D designs into very thin layers using computer software. These layers are then printed one on top of the other using 3D printers until the final shape is formed. This system differs from molding and sculpting systems, which waste more than 90% of the material used in manufacturing. 3D printers are generally faster, more economical, and easier to use than other manufacturing technologies. 3D printers enable developers to print complex interlocking parts, and it is also possible to create parts from different materials with varying mechanical and physical properties and then assemble them. Advanced 3D printing technologies produce models that closely resemble the appearance, texture, and function of the product's prototype. Note: The air conditioner's outer body was manufactured using a 3D printer

evaporator



The cycle is called a vapor-compression cycle because the compressor compresses the refrigerant vapor from a low pressure to a high pressure. This compression process causes the transfer of heat energy from inside the refrigerated space to the outside.

Freon



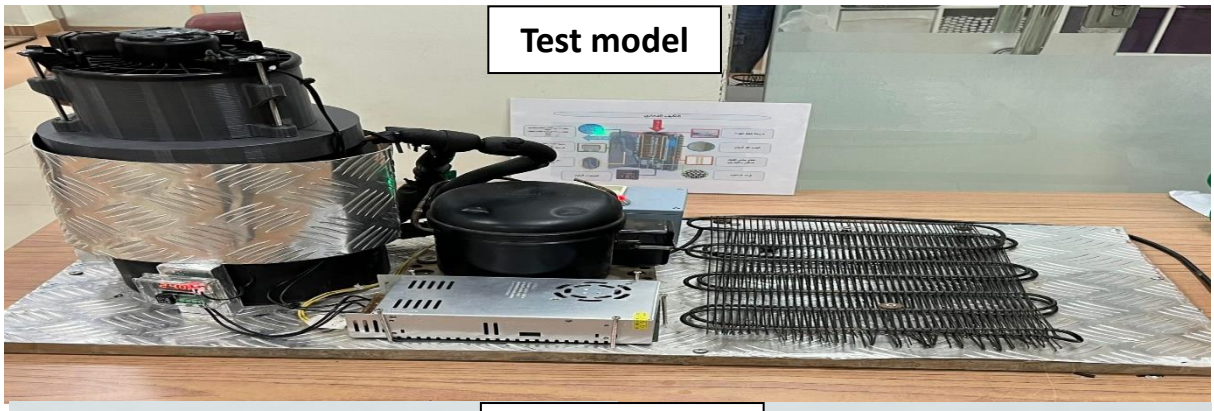
Refrigerant (Freon), as a component of an air conditioner, is a special fluid essential for refrigeration and freezing technology. It operates in a closed loop and It transfers heat from the inside to the outside outside of an area. Refrigerant is used because it changes its state from a liquid to a vapor at temperatures suitable for the refrigeration cycleWe use refrigerant gas because its state changes from liquid to vapor at temperatures appropriate for the refrigeration cycle

Assemble the model

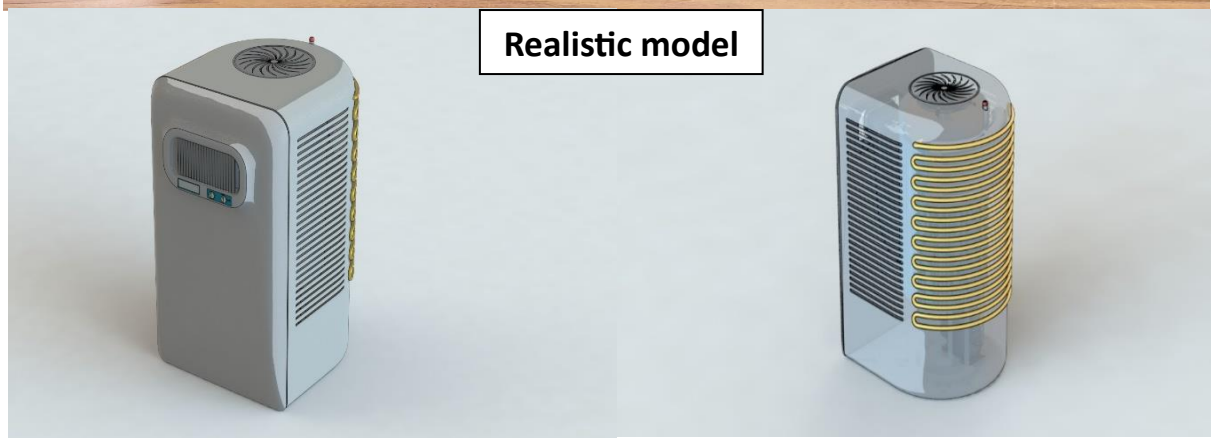
We installed and assembled all of the above parts and operating and control devices into a base and installed it

In a correct and distinctive way, control its operation and read the results

(The picture shows the final model of the air conditioner)



Test model



Realistic model

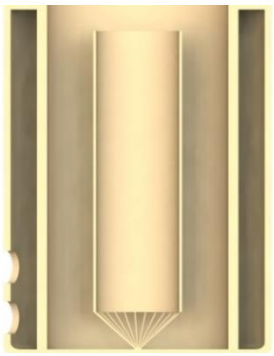
(Video explaining the process of the pottery conditioner stages)

https://youtu.be/984jmE2u860

Explain the project process

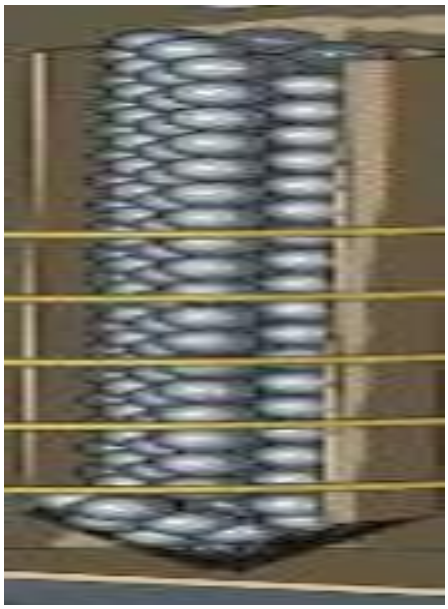
1- Mechanism of Clay

The method of making Clay inside the air conditioner is an innovative method. It is known that Clay cools the water and draws water with its porous properties. The Clay wall becomes wet, and when the air passes over the surface, the water cools from the inside. However, in the Clay air conditioner, these properties were exploited in an innovative way and we made the water outside the Clay and the air from the inside. The inner surface of the Clay becomes wet and the passage of air becomes cold.



2- The mechanism of action of aluminum balls

The work of aluminum inside the air conditioner is an intensive cooling mechanism, as this type of metal has cooling properties, such as the speed of cooling of metals and maintaining the coolness of aluminum inside the Clay. The coolness is increased and maintained for a long time, which makes the compressor not work for a longer time



3- Compressor mechanism

The compressor is the element responsible for extracting the refrigerant vapor from the , The evaporator compresses it and then pushes it to the condenser. To understand the function of the compressor, you must know that the refrigeration cycle goes through several stages to produce refrigerant used in air conditioning.

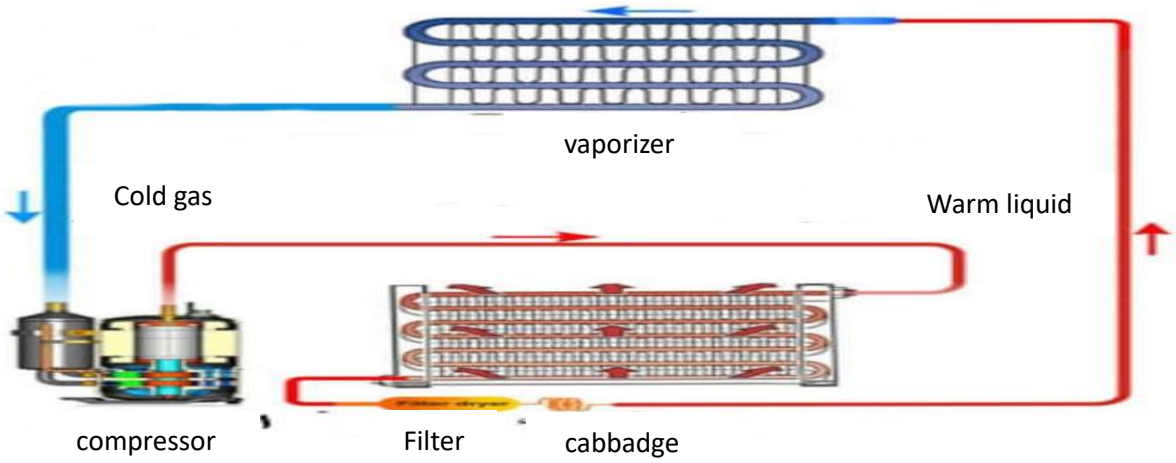
Basic cooling circuit:

A liquid evaporates by gaining heat and condenses when heat is removed from it. Cooling is a cyclical process in which a liquid changes from a liquid to a gaseous state, then to a liquid to a gaseous state, and so on. The liquid must evaporate to gain heat, while when it condenses, some of the latent heat in the gas is expelled again.

pressure stage:

The compressor is responsible for this stage, as it draws the refrigerant vapor from the evaporator pipes and then compresses it, so the temperature of the refrigerant rises, and then the compressor pushes the compressed refrigerant vapor to the discharge line to reach the condenser. Here begins a new stage, which is the condensation stage.
In the condensation stage, the compressed refrigerant vapor is expelled to the condenser in the form of hot vapor or gas at high pressure. The goal of this stage is to cool or remove heat from the refrigerant vapor, depending on the condenser cooling method. The refrigerant vapor begins to condense to transform from a gaseous state to a liquid state, so we say: At this stage is the condensation stage and the part responsible for the condenser.

After the refrigerant vapor is condensed and turns into a high-pressure liquid, the expansion stage comes. In this stage, the refrigerant passes through an element called the expansion valve to enter the evaporator in a small quantity with the aim of turning from a liquid into a gas again in the evaporator, producing cooling, meaning that the refrigerant liquid evaporates, so this stage is called evaporation , the element responsible for it is the evaporator.
Then the compressor draws the refrigerant vapor from the refrigerant and the cycle repeats, the compressor is considered the heart of the refrigeration circuit in the air conditioner.



4- The mechanism of the clay air conditioner in general

How the clay air conditioner works When the air conditioner is turned on, the compressor starts the journey of transporting and compressing the refrigerant gas or Freon and the gas is compressed with the force of the compressor, the temperature rises and goes to the condenser and after the gas condenses it becomes a compressed liquid and then collects in the expansion valve and works to separate moisture and impurities and the liquid moves to the evaporator to become a cold liquid that passes through the copper pipes inside the water between the clay and the plastic structure in order to cool the water and in the meantime the fan works to bring the outside air inside between the aluminum balls and the passage of air over them and between them makes the aluminum cool faster with the clay properties makes the air cool so that we have an air conditioner that consumes less electricity and is more efficient and in the air conditioner we were able to reduce the time that the compressor works

Calculate energy and power as follows:

Calculate the electrical capacity of the clay air conditioner : 0.56 A*220V=123.2w

P=V*IP=? I=0.56A. V=220v

Energy calculation

W=P*H=123.2*1=123.2wh>>123.2/1000=0.1232kwh

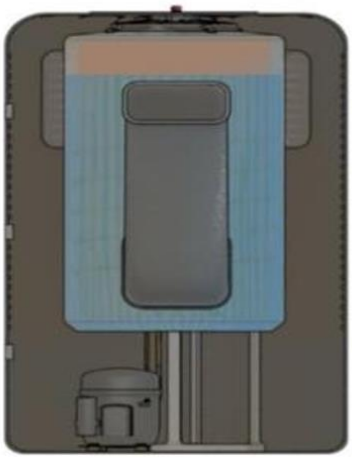
.P=123.2w.Hour=1 Tariff=0.18

Energy consumption per hour in Saudi Riyals: Energy x Tariff =

0.1232*.18 =0.022 riyals

Assuming that the air conditioner was operated for 10 hours for two days,

The total cost per month is 6.6 riyals.



comparison

(compressor comparison)

Compressor for air conditioner

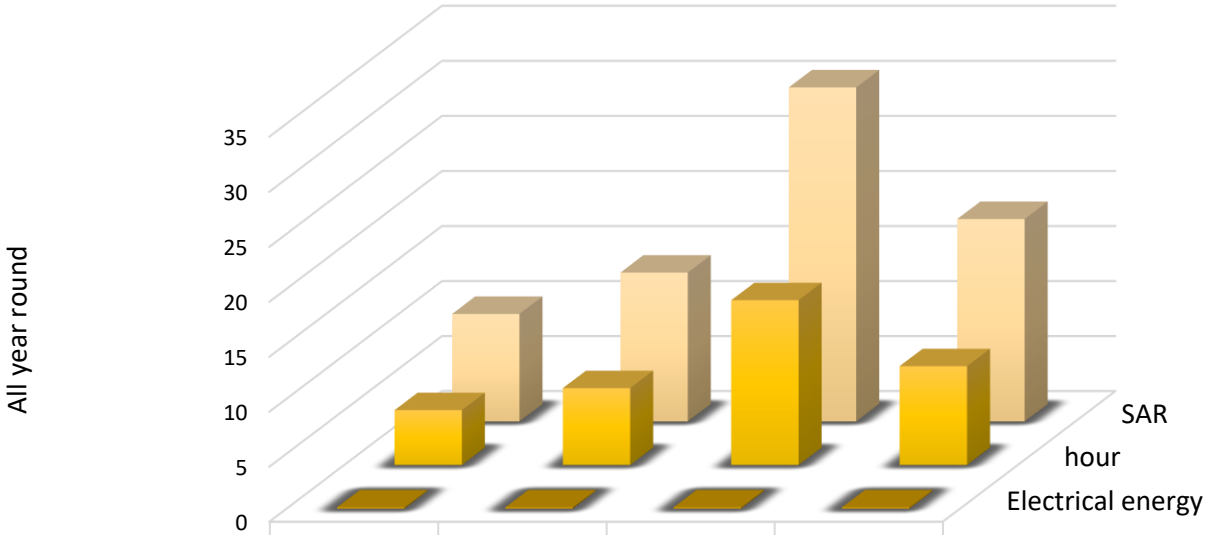
Compressor used = 5L/HR capacity air conditioner water cooling area

Electrical power: 123 watts

Energy: 0.1232 kWh

Energy consumption per hour in riyals: 0.022 riyals

Compressor in clay air conditioner



	Winter season	Spring season	Summer season	autumn
Electrical energy	0.1232	0.1232	0.1232	0.1232
hour	5	7	15	9
SAR	9.79	13.55	30.36	18.414

small freon compressor

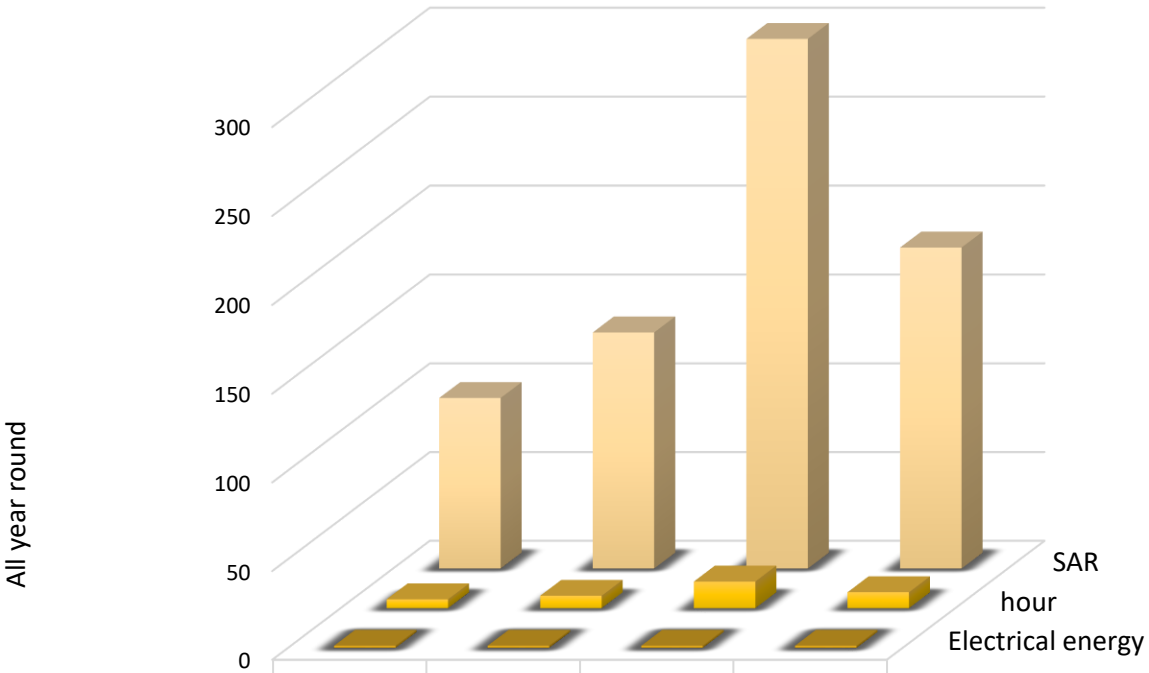
The compressor used in the small Freon air conditioner is 12 thousand one

Electrical power : 1200 watts

Energy : 1.2 kWh

Energy consumption per hour in riyals: 0.216 riyals

Small Freon air conditioner compressor



	Winter season	Spring season	Summer season	autumn
Electrical energy	1.2	1.2	1.2	1.2
hour	5	7	15	9
SAR	96.12	133.056	298.08	180.792

References

1. https://mawdoo3.com/%D9%81%D9%88%D8%A7%D8%A6%D8%AF_%D8%A7%D9%84%D9%87%D9%88%D8%A7%D8%A1
2. https://futureskills.mcit.gov.sa/ar/group/6751
3. https://ar.m.wikipedia.org/wik
4. https://ar.m.wikiversity.org/wiki
5. https://mawdoo3.com/%D8%AE%D9%88%D8%A7%D8%B5_%
6. https://ar.quora.com
7. https://www.voltiat.com/method-for-converting-

CAC Estimate Feasibility Study

Specification of Needs by Implementation Stages

First Stage:

- **Providing the required workspace**
  (For example, in a mosque) with dimensions (length × width × height = 5m × 45m × 2.5m) per air conditioner unit.
- **Work Plan and Task Allocation** according to specialization:
  - **Technical Supervision**: Technical College in Jeddah
  - **Execution Supervision**: Eng. Hassan Al-Aidroos
  - **Primary Executor**: Trainee Salah Hassan Bakr
  - **Secondary Executor**: Trainee Youssef Abdulbari Al-Aidroos
  - **Tertiary Executor**: Trainee Mohammed Ahmed Al-Dhubai
  - **Follow-up and Management**: (.....)
  - **Supporting Entity**: (.....)

(Designs)

Second Stage:

The clay air conditioner consists of:

1. **Outer Structure**: A cylinder made of plastic via 3D printing.
2. **Cover for Outer Structure**: Also made of plastic via 3D printing.
3. **Inner Cylinder**: A handcrafted clay cylinder made from organic Italian clay, specialized for cooling tasks.
4. **Copper Tube Installation**: Installed and welded to a Freon compressor, along with an evaporator (condenser coils).

Third Stage:

- **Procurement of Internal and External Parts**:
  - Freon Compressor
  - Mounting Base
  - Aluminum Balls
  - Copper Tube
  - Air-Propelling Fan
  - Air Duct
  - Evaporator (Condenser Coils)
  - Control Panel
  - Screws
  - Iron Sheet
  - Thermostat
  - Electrical Wiring
  - Electrical Switch
  - Lighting
  - Electrical Plug
  - Temperature Gauge
  - Clay
  - Distilled water

Costs

Costs for the First Stage:

Estimated project value:

In the case of an investor entering into an agreement to manufacture the product with an investment of 2 million riyals (as a partner).

Project implementation costs if awarded to an investor.

- Technical Supervision Costs: 8,000 SAR per month
- Field Execution Supervision Costs: 5,000 SAR per month
- Maintenance Costs: 7,000 SAR per month

Phase 2 costs:

Operating costs			
	number	the price	note
Freon compressor	1	350SAR	
Electrical wires	5m	20SAR	Required wire size: 1.5 mm
AC to DC converter	1	70SAR	
temperature gauge	1	175SAR	
Freon		45SAR	
Data screen	1	144SAR	
Air filter	1	188SAR	
Air blower fan	1	100SAR	
Control panel	1	117SAR	
A*220V=123.2w0.56 Calculate the electrical power of the clay air conditioner =V*I P=? I=0.56A. V=220v Calculate the power: W=P*H=123.2*1=123.2wh>>123.2/1000=0.1232kwh .P=123.2w. Hour=10.18 Energy consumption per hour in Saudi Riyals: Energy x Tariff = 0.18 x 0.1232 0.022 Riyals Assuming that the air conditioner was operated for 10 hours for two days, The total cost per month is 6.6 riyals.	For every additional cooling meter in the area, the price is multiplied by 3 times the price shown.		
the total	1220.6SAR		

Total project	=	21215SAR

Stage Three

	number	the price	note
Clay cylinder	1	100 SAR	
Freon compressor	1	50 SAR	
Aluminum balls	2k	20 SAR	
Iron sheet	1	49 SAR	
Wood panel	1	35.5 SAR	
Electrical wires	2m	10 SAR	
Electric switch	1	2.5 SAR	
lighting	1	15 SAR	
Electric press	1	4 SAR	
Printing cost		155 SAR	
temperature gauge	1	92 SAR	
AC to DC converter	1	146 SAR	
thermostat	1	35 SAR	
screws	15	2 SAR	
copper tube	1m	150 SAR	
Air blower fan	1	20 SAR	
Airway	1	10 SAR	
hard plastic cylinder	1	125 SAR	
Control panel	1	45 SAR	
(condenser files) The good one	1	30 SAR	
the total		1096 SAR	

Comparison with a similar project

Clay air conditioner	
Electrical capacity	123.2W
Energy consumption in Saudi Riyals per hour	0.022SAR
Highest temperature	C 13.5
Compressor disconnect time	40minutes

comparison

Freon air conditioner	
Electrical capacity	1200W
Energy consumption in Saudi Riyals per hour	0.216 SAR
Highest temperature	C 18
Compressor disconnect time	15 minutes

Recommendations:

Positives:

1. Provides electricity savings: each clay air conditioner consumes half as much electricity as a traditional freon-based unit .
2. Reaches a high level of cooling compared to other types of air conditioners.
3. Lightweight, easy to maintain, and cost-effective.

Negatives:

1. The clay material may accumulate salts over time due to its high porosity, which can affect the smooth flow of air toward the exit vent.
2. Salt buildup can also impact the heat exchange on the clay's surface, thus reducing cooling efficiency. Therefore, it is recommended to use distilled water for cooling the outer surface of the clay unit.