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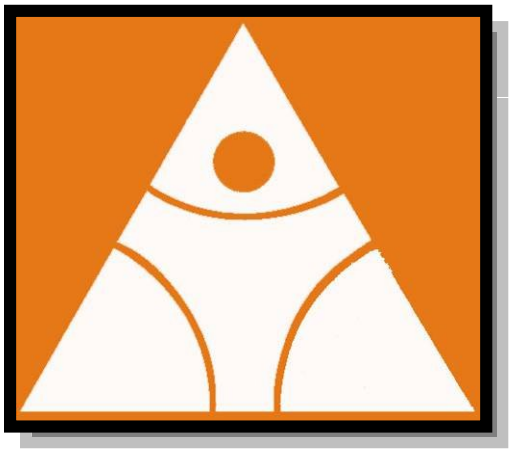

PROJECT'S NAME

Using transparent wastes as "Transparent thermal insulators"

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SUMMARY;

Nowadays people have big problems to maintain enough energy for their normal life needs, and to deal with big amount of municipal wastes that we are producing each second, so as a solution to those, we thought about finding new energy sources but also effective to the problem of big amount of municipal wastes, and to air pollution. As a solution, we aimed to study the usage of **transparent thermal insulators** that are really effective solution for heat conservation and at the same time is super solution against wastes. Transparent thermal insulators are made of transparent wastes such as; plastics, glass, cellophane, nylon, etc. At the same time we can produce effective thermal insulators that will reduce our energy needs and we can also reduce emission of hazardous gasses that are produced by systems for heating objects as heat needs will be reduced because of better heat conservation. And secondly we can clean our environment from transparent wastes that make about 15 to 20% of municipal wastes. By using those wastes for production of transparent thermal insulators we can solve the problem of these wastes without producing many dangerous gasses during recycling process. We can also maintain new workplaces for many poor people that will be working to collect and select all of transparent materials (wastes) needs for production of **transparent thermal insulators**.
So the transparent thermal insulators are solutions for many of our daily problems, just we need to finish researches completely and use them to increase people's life standards and to supply people's needs.

AIMS OF THE PROJECT;

1- To clean our environment.
2- To protect our atmosphere.
3- To reduce the usage of natural fuels, and coal.
4- To improve our building techniques.
5- To decorate our homes.
6- To increase people's life standards and to supply people's needs.

INTRODUCTION;

Ecology is the study of the relationship of plants and animals to their physical and biological environment. The physical environment includes light and heat or solar radiation, moisture, wind, oxygen, carbon dioxide, nutrients in soil, water, and atmosphere. The biological environment includes organisms of the same kind as well as other plants and animals do.

Because of the diverse approaches required to study organisms in their environment, ecology draws upon such fields as climatology, hydrology, oceanography, physics, chemistry, geology, and soil analysis. To study the relationships between organisms, ecology also involves such disparate sciences such as animal behaviors, taxonomy, physiology, and mathematics.

Energy and pollution

Two main problems of modern society are insufficiency of energy and pollution. Population has been doubled in the last 25 years, and the usage of energy per capita has been tripled. Energetic needs of human population in the last 25 years were increased 6 times. In 1998 the usage of energy was 8477 Mten (amount of energy equal to affect if 8477 tons of oil had been burned), and that is for 11.3% greater than in 1990. In USA from 1990 to 1998 the usage of energy increased for 12, 9%, and usage of coal for 8%.

In European countries the usage of coal is considerably reduced. The usage of primary energy in 1998 ,In European countries, was 1787,7 Mten: 759,6 Mten of oil, 384,5 Mten of natural gas, 350,5 Mten of coal, 242 Mten of nuclear energy and 50,3 Mten of hydro energy. Comparing these facts with usage of energy in 1990, we can see that usage of: natural gas has been increased for 29, 4%, of nuclear and hydro energy for 17,5%, of oil for 7,1%, and the usage of coal has been decreased for 27,7%.

From total energy needs people use about 40% of energy for heating of water for hygiene, preparing food and for maintenance of beneficial microclimatic condition in living and working spaces. For these needs people mainly use fossil fuels; coal, oil, natural gas, wood, etc. Usage of fossil fuels is harmful to environment. The reserves of fossil fuels are limited. One day those will just simply disappear and leave us without energy sources. We should think about new energy sources. In these considerations solar energy is unavoidable. That is renewable energy present around us in big quantities. That is the purest type of free energy. After usage of this type of energy there are no harmful consequences for environment and there are no problems with waste disposals.

The consequences of sudden development caused big needs for energy. Needs for energy have tendency to increase. There are many thermal power plants which use coal. Most of vehicles use liquid fossil fuels. Pollution of environment and atmosphere is disastrous. Atmosphere absorbs big amount of harmful gasses and smoke. Harmful gasses contact with water steam and carbonic, nitrogenous and sulfuric acids are made.
Then these acids make acid rains. Acid rains destroy big complexes of plant life, and due to this, animal world and arable lands are in danger. Many regions had lost their living world. Acid rains are destroying flora and fauna in rivers, lakes, seas and oceans. Many plant and animal species are in great danger of distinction. Solar emission is being lost away through smoke molecules that handicap emission to reach the Earth surface. Natural disinfection of the Earth by sunlight is prevented. Smoke absorbs heat and prevents normal cooling of the Earth surface during night. That causes global warming of atmosphere and global increase in temperature on Earth. According to world meteorological organization (WMO) and program of UN for protection of people environment, we can conclude that until the end of this century temperature in world will increase for 1 to 3,5°C, and sea level for 0,15 to 0,95 meters. These changes will have negative effects on living environment. Ice melting causes climate changes on Earth and increase of sea level. Floods, earthquakes, hurricanes and tsunamis have become usual events. Modern society is aware of this situation. Modern society is applying adequate actions on international level. On conference about climate changes in Kyoto 1997 many associations told that emission of gasses that help "green house effect" should be decreased for 5% in period from 2008 to 2012. This would be done by NATO countries. European Union promised to decrease emissions by 8%, USA by 7% and Canada by 6%.

On UN conference held in Rio de Janeiro 1992, new "Agenda 21" has been declared. This document has purpose to prepare people for 21.st century. Countries that had confirmed this document have taken some obligations, as: to reduce usage of lands, to reduce usage of energy sources, and to try to keep and protect biological equilibrium. Also they promised to stop processes that bring damage to our environment and at the same time directly to people's health and development. On the Milano conference held in 1996 "White book" has been declared, that has one main aim and that is to increase in (RES) renewable energy sources from 6% in 1998 to 12% in 2010. For this project on the international plan approximately 95 billion of dollars will be spent. On Amsterdam conference from May 1999, they predicted the usage of renewable energy sources as shown in table: **T-1**

Type of alternative energy sources	**Level of usage in 1995.g.**		**Plan of usage for 2010.g.**	
Solar cells	0,03 GWp		3 GWp	
Solar thermal collectors	6,5 M m^2		100 M m^2	
Passive solar applications			35 Mten	
Hydro energy	95 GW		105 GW	
Wind energy	2,5 GW		40 GW	
Biomass energy	44,8 Mten		135 Mten	
Geothermal energy - electric - heat	0,5 GW	1,3 GW	1,0 GW	5,0 GW

Solar Energy

Solar Energy, radiation produced by nuclear fusion reactions deep in the Sun's core. The Sun provides almost all the heat and light Earth receives and therefore sustains every living being.

Solar energy travels to Earth through space in discrete packets of energy called photons. On the side of Earth facing the Sun, a square kilometer at the outer edge of our atmosphere receives 1,400 megawatts of solar power every minute, which is about the capacity of the largest electric-generating plant in Nevada, USA. Only half of that amount, however, reaches Earth's surface. The atmosphere and clouds absorb or scatter the other half of the incoming sunlight. The amount of light that reaches any particular point on the ground depends on the time of day, the day of the year, the amount of cloud cover, and the altitude at that point. The solar intensity varies with the time of day, peaking at solar noon and declining to a minimum at sunset. The total radiation power (1.4 kilowatts per square meter, called the solar constant) varies only slightly, about 0.2 percent every 30 years. Any substantial change would alter or end life on Earth.

The solar energy that falls naturally on a building can be used to heat the building without special devices to capture or collect sunlight. Passive solar heating makes use of large sun-facing windows and building materials such as ***transparent thermal insulators (that will be mentioned later)*** that absorb and slowly release solar heat. A designer plans the building so that the longest walls run from east to west, providing lengthy southern exposures that allow solar heat to enter the home in the winter. A well-insulated building with such construction features can trap the Sun's energy and reduce heating bills as much as 50 percent. Passive solar designs also include natural ventilation for cooling. Shading and window overhangs also reduce summer heat while permitting winter Sun.

Wastes that pollute our environment

A person living in an industrialized nation may produce as much as 695 kg of municipal solid waste. This figure includes a wide variety of items, often a mix of potentially reusable or recyclable items (such as newspapers and cans) and largely no recyclable material (such as broken or worn-out devices and plastic packaging). Modern way of life requires plastic packing of articles for one termed use. Types of waste materials and period of their biodegradation are shown in table; **T-2**

Waste type	Period of biodegradation
Plastic bags	**1000- 10 000 years**
Polystyrene	**1000 years**
Glass bottles	**4 000 years**
Plastic bottles	**100-1000 years**
Plastic lighter	**100 years**
Cans	**10-100 years**
Chewing gum	**5 years**
Cigarette filter	**1-2 year**
Newspapers	**3-12 months**
Apple trash	**3-6 months**
Paper handkerchief	**3 months**

These packages are big problems for our environment. Secondary raw materials pollute the environment and are real ecological catastrophe. Glass bottles, plastic bottles, nylon bags, paper bags, cans and clothes "decorate" our rivers, lakes and seas.

Morphological composition of communal wastes is shown in Table **T-3**:

Type of communal waste	Weight percent (%)
Wastes easy for biodegradation	37
Paper	26
Glass	9
Plastic	6
Metals	2
Other wastes	20

Lots of materials can be recycled and again used for production of large number of articles in construction industry. Materials which can be degraded fast could be used for production of fertilizer. Developed countries have special electric power plants which safely burn wastes and produce electric energy, but our project represents usage of wastes for heating of object without big pollutants as electric power plants are.

Glass

For centuries, glass has served as a universal packaging container, holding precious commodities like wine and olive oil. Today, manufacturers use glass to hold everything from soda and peanut butter to champagne and perfume. Glass manufacturers and consumers continue to appreciate glass for its aesthetic value but also recognize its practicality. The glass has become one of the main wastes.

Plastics

Since the development of plastic earlier this century, it has become a popular material used in a wide variety of ways. Today plastic is used to make, or wrap around, many of the items we buy or use. The problem comes when we no longer want these items and how we dispose of them, particularly the throwaway plastic material used in wrapping or packaging. Plastics are used because they are easy and cheap to make and they can last a long time. Unfortunately these same useful qualities can make plastic a huge pollution problem. The cheapness means plastic gets discarded easily and its long life means it survives in the environment for long periods where it can do great harm. Because plastic does not decompose, and requires high energy ultra-violet light to break down, the amount of plastic waste in our oceans is steadily increasing. As we have said recycling of plastics can be really dangerous for the environment and is very hard to achieve, so plastics become big waste problem.

Plastic bags

Every year, around 500 billion (500,000,000,000) plastic bags are used worldwide. So many that over one million bags are being used every minute and they're damaging our environment.

Yet, precious little has been done to recycle, re-use and dispose of plastic waste. Plastic bags are difficult and costly to recycle and most end up on landfill sites where they take around 300 years to photo degrade. They break down into tiny toxic particles that contaminate the soil and waterways and enter the food chain when animals accidentally ingest them. But the problems surrounding waste plastic bags starts long before they photo degrade. Our planet is becoming increasingly contaminated by our unnecessary use of plastic carry bags. Big black bin liners, plastic carrier bags carrying advertising logos, clear sandwich bags, vegetable bags and a variety of other forms used to carry our daily food items and other items are all polluting our environment. Just take a look around you. Plastic bags can be seen hanging from the branches of trees, flying in the air on windy days, settled amongst bushes and floating on rivers.

Every bag that's washed down a drain during rainfall ends up in the sea every bag that's flushed down a toilet (many mall bags are), ends up in the sea - every bag that’s blown into a river will most likely end up in the sea. Besides choking drains, plastics are highly toxics. When burned they release cancer-causing gases. Lying in the garbage, polythene bags also find their way in gut of cattle, asphyxiating the animals. The cheap bags contain chemicals such as cadmium- or lead-based chemicals that are harmful to health. They leach into vegetables, meat and food.

Quick facts on plastic pollution

- A plastic milk jug takes 1 million years to decompose.
- A plastic cup can take 50 - 80 years to decompose.
- Americans use 2.5 million plastic bottles every HOUR.
- Plastic bags and other plastic garbage thrown into the ocean kill as many as 1 million sea creatures every year.
- Today, Americans generate 10.5 million tons of plastic waste a year but recycle only 1 or 2 % of it.
- An estimated 14 billion pounds of trash, most of it is plastic is dumped in the world's oceans every year.
- The worldwide fishing industry dumps an estimated 150,000 tons of plastic into the ocean each year, including packaging, plastic nets, lines, and buoys.
- About 1,200 plastic soft drink and salad dressing containers could carpet the average living room.
- Nearly every piece of plastic EVER made still exists today.

Picture 1. Plastic pollution examples

Air Pollution

For the air pollution observations we took Tuzla and Sarajevo cities as examples, where all of our observations on our project had been done. In these cities, people are using coal, wood, oil and natural gas for heating.

Basic information about gasses released by usage of coal, natural gas and others are shown in table T-4:

Table T-4

FUEL	H_2O (g/kWh)	CO_2 (g/kWh)	CO (g/kWh)	SO_2 (g/kWh)	NO_x (g/kWh)	Ash and grime (g/kWh)
Coal	**150**	**1200**	**0,10**	**10,0**	**2,5**	**2,00**
Light distillate oil	**250**	**750**	**0,01**	**7,0**	**2,5**	**0,30**
Natural gas	**400**	**600**	**0,01**	**-**	**2,0**	**0,05**

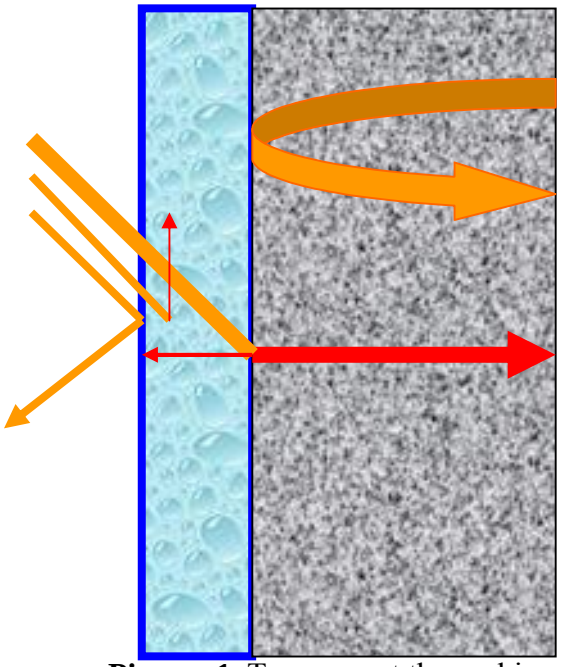
TRANSPARENT THERMAL INSULATORS

Transparent waste materials such as; glass, nylon, cellophane and plastics can be used for production of transparent thermal insulators. Those materials are transparent to visible light, and also those are good thermal insulators. Mounting those on outside vertical surfaces of living spaces can be used for passive solar energy collecting and protection of living spaces from aero pollution. Collected sunlight on outer surface of walls is being transformed into heat, easily accumulated in walls and directed to the inside of the living and working spaces. By usage of transparent thermal insulators secondary raw materials that are present in huge amounts in our environment will become very wanted raw materials. Wastes should be selected in households, and collected in special containers before it mixes with other trash.

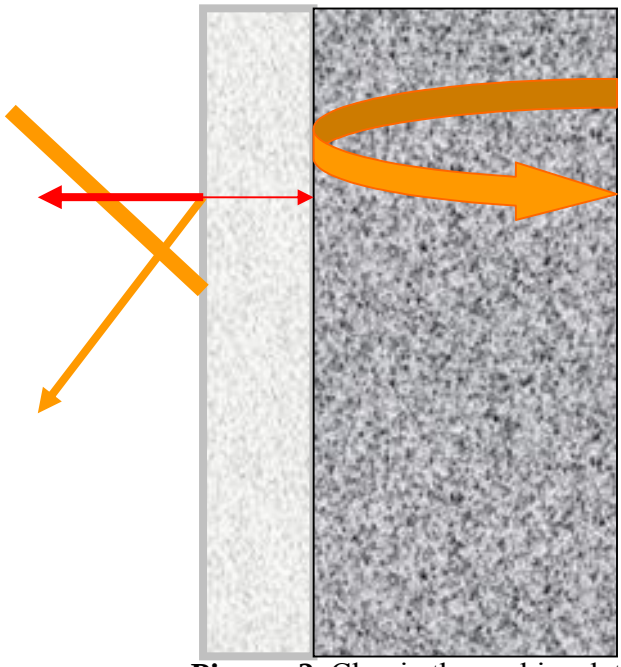
Harm on ecology and environment will be considerably decreased. Rivers, lakes and seas will be less polluted. Savings in usage of energy and fossil fuels will be considerably decreased. Atmosphere will be cleaner and more airy. The concentration of acid rains will be decreased. Many plant and animal species will escape from distinction. Erosion of arable lands will be decreased. Climate will become stabilized. Living environment will become more beautiful and healthier.

TRANSPARENT THERMAL INSULATOR'S WORKING PRINCIPLE

Transparent thermal insulators working principle is shown on (Picture 1.), and of classic thermal insulators on (Picture 2.).



Picture 1. Transparent thermal insulator



Picture 2. Classic thermal insulator

Classic thermal insulator has a role to keep the heat which is used to heat the object, and transparent thermal insulator has the same role, but also to collect solar energy, transforms it into heat and directs to wall. Wall easily absorbs the heat and conducts it towards inside of the object and by that it helps heating of indoor spaces. Thermal maximum on outer surface of the wall is at noon, and thermal maximum of inside surface of the wall appears later. By changing material type and wall thickness thermal maximum of inside surface of the wall can be delayed to the evening (when it is the coldest time of the day). The amount of heat which has been collected inside of the object can be regulated by size of receiving area, by transparency of transparent thermal insulator and by absorption coefficient of transparent thermal insulator.

Efficiency coefficient is directly proportional to absorption coefficient, transparency coefficient, and passage coefficient of heat through wall and inversely proportional to passage coefficient of heat through transparent thermal insulator.

For the experiment part of our project we made twenty boxes using window glass 2 mm thick, with inside volume of 60x60x5cm^3 = 18 dm^3 = 18 liters. Inside of those boxes we put broken glass, nylon, plastics, cellophane and mix transparent wastes.

METHOD;

According to us, transparent thermal insulators are very good solution for heating and pollution. To prove our idea, we performed a simple experiment which shows the realities about transparent thermal insulators. At the first time we made two experimental houses in Tuzla where we did our first observations, as our transparent thermal insulators had shown that are more effective than classic ones we decided to make new observations in Sarajevo.

Steps performed for our investigation in Sarajevo are written below;

1-First of all, we made 4 different groups to collect transparent wastes around our school. Each group collected a different type of transparent wastes; plastic bags, plastic bottles, glass parts and cellophane.

2-We cut these transparent wastes into very small pieces.

3-We made 20 glass boxes in the dimension of 60x60x5 cm. We put these transparent wastes into glass boxes. 4 glass boxes were filled with plastic bag pieces, 4 glass boxes were filled with plastic bottle pieces, 4 glass boxes were filled with glass pieces, 4 glass boxes were filled with cellophane pieces and 4 glass boxes were filled with mix transparent wastes.

Transparent thermal insulator panels
(Plastic bottles, cellophane, glass, mix transparent wastes and plastic bag)

4-We built 6 different small houses on the roof of our school and we insulated the outer surfaces of our small houses with our glass boxes filled with transparent wastes. The 1st house was insulated by plastic bags, the 2nd house was insulated by plastic bottles, the 3rd house was insulated by cellophane, the 4th house was insulated by glass, the 5th house was insulated by mixed transparent wastes and the 6th house was insulated by classic thermal insulator.

5-When we were doing these steps; we left 5 holes with small pipes for each house to measure the temperatures every day. 1. East hole was left between insulator and wall, 2. East hole was left on the inner side of the wall; 3.hole was left in the middle of the house on the east, 4. West hole was left between insulator and wall and 5. West hole was left on the inner side of the wall.

6-Later, we measured temperature changes for five weeks and we obtained very important results given below.

Objects in Tuzla and Sarajevo (locations where observations had been done)

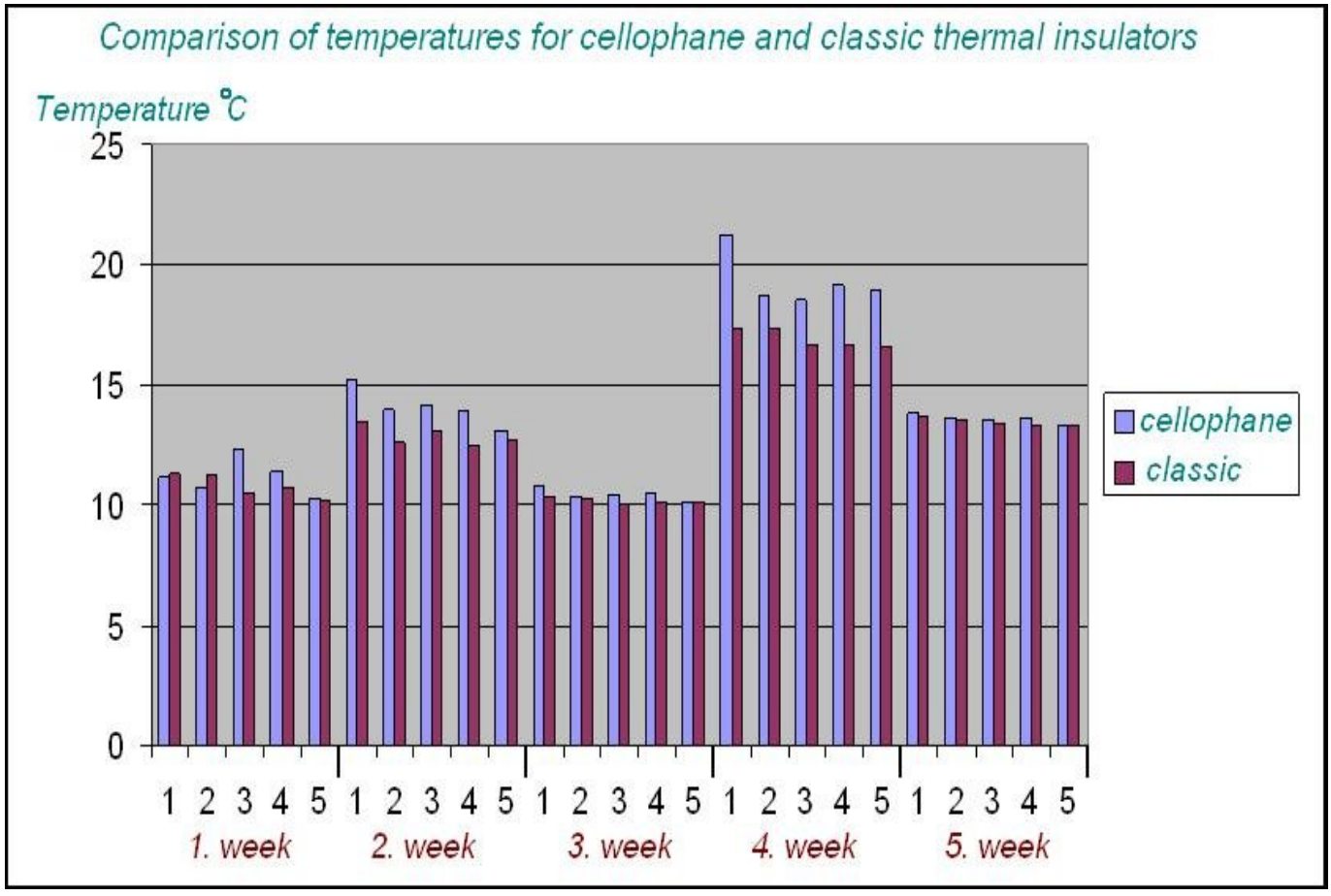
RESULTS AND DISCUSSION;

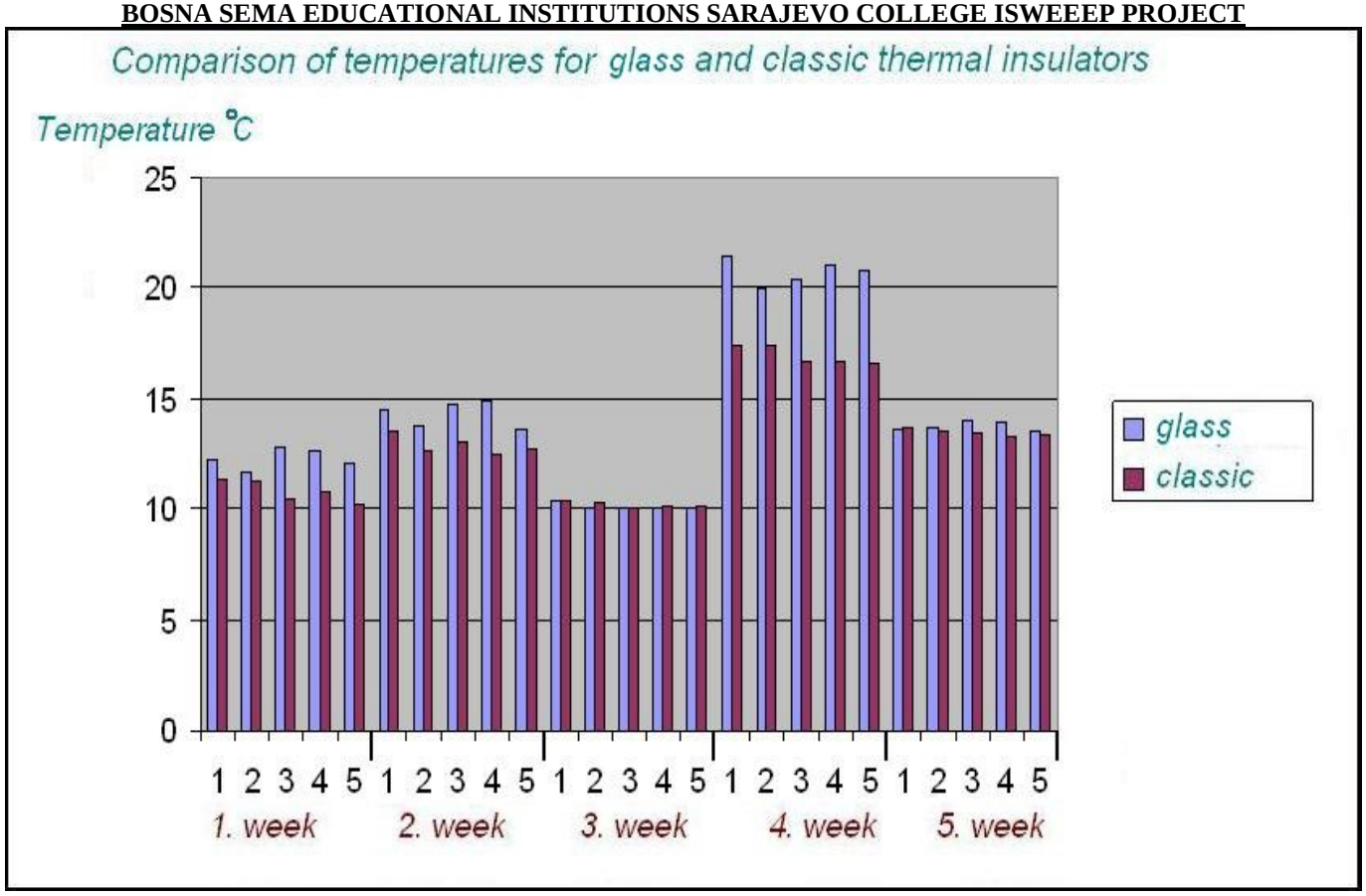
For the five weeks we had made observations on our experimental objects and we measured temperature changes and compared those samples to the temperatures of the classic thermal insulator.

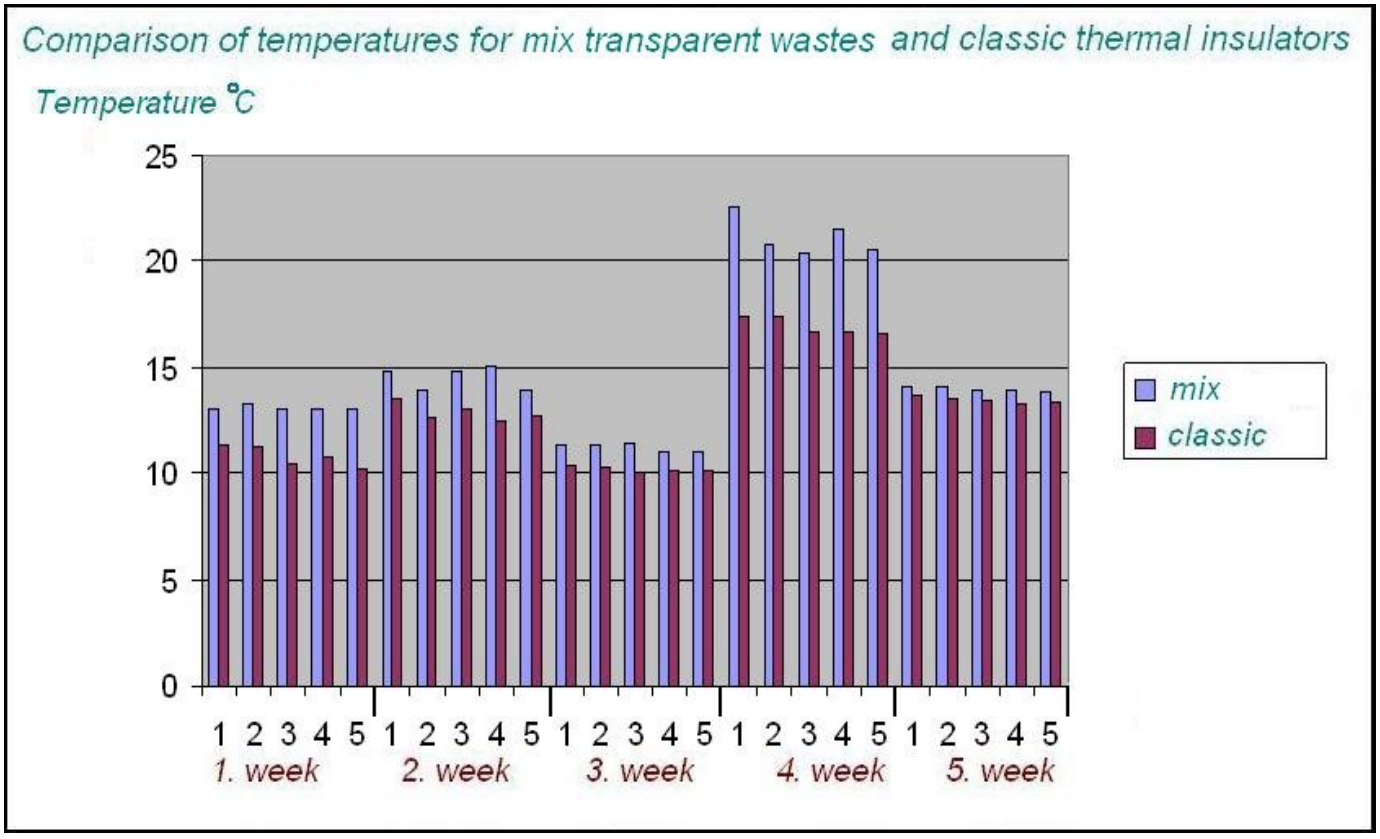
Following numbers in the graphs are showing different temperatures of different places in our objects;
1-Temperature between the surface of insulator and outer surface of wall (eastern)
2-Temperature on the inner surface of wall (eastern)
3-Temperature of inside of object
4-Temperature between the surface of insulator and outer surface of wall (western)
5-Temperature on the inner surface of wall (western)

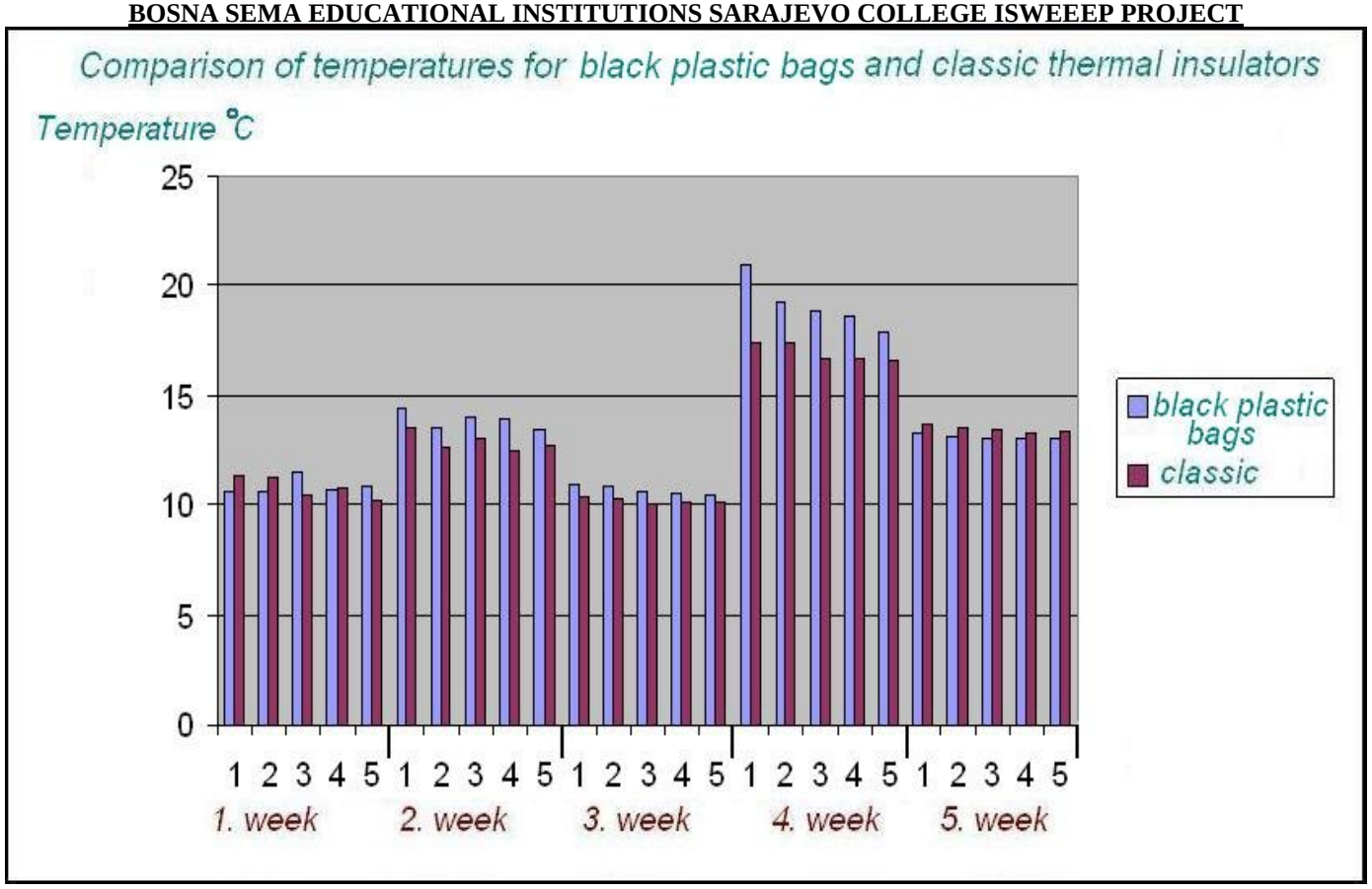
In the each graph, transparent thermal insulator is more effective than classic thermal insulator. For our glass panels, we can use other objects instead of glass ex. transparent plastics and if we improve our investigations more we can find many more effective and cheaper materials for insulation and of course we can solve air pollution and waste pollution in the ecosystem by this way.

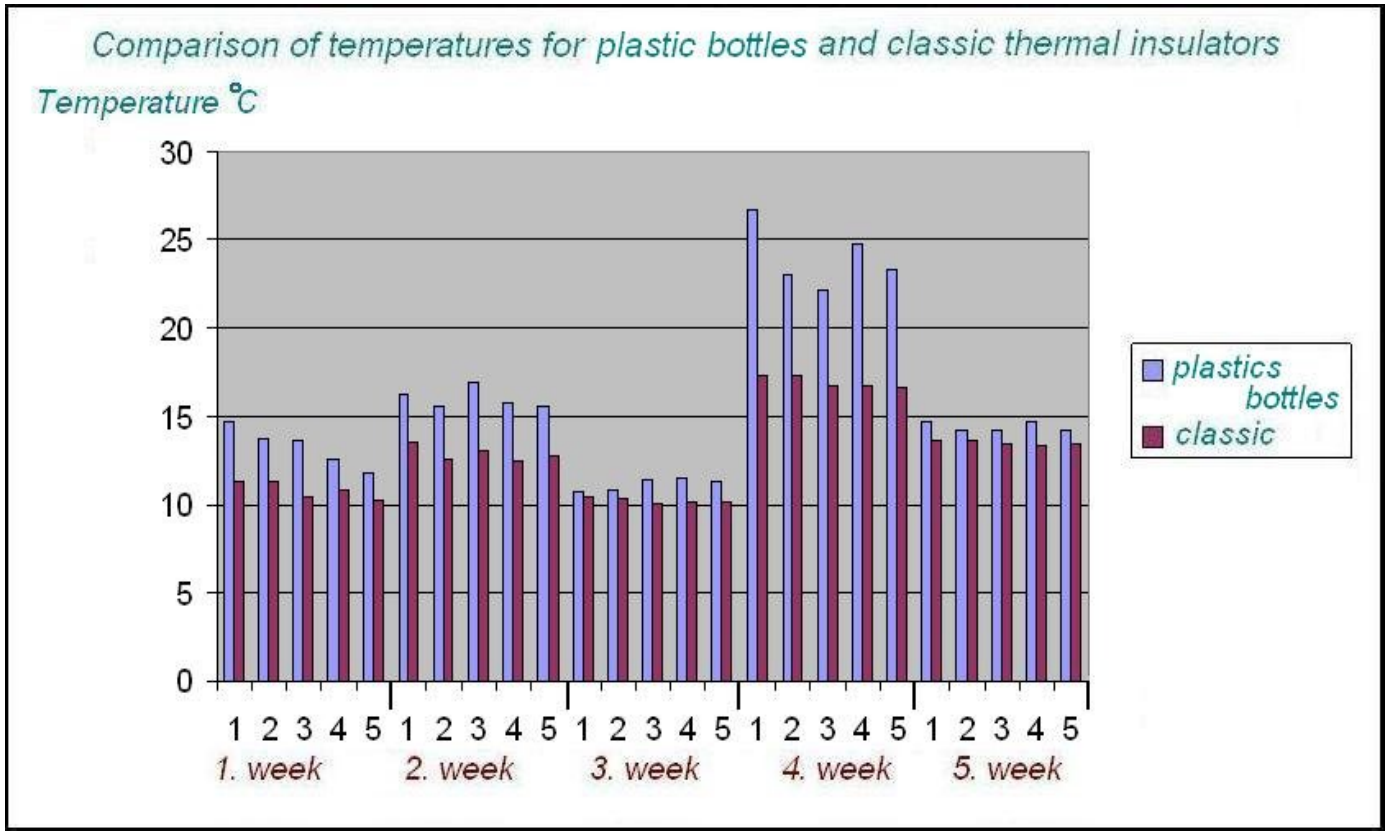
Measurement results are shown in the graphs below;



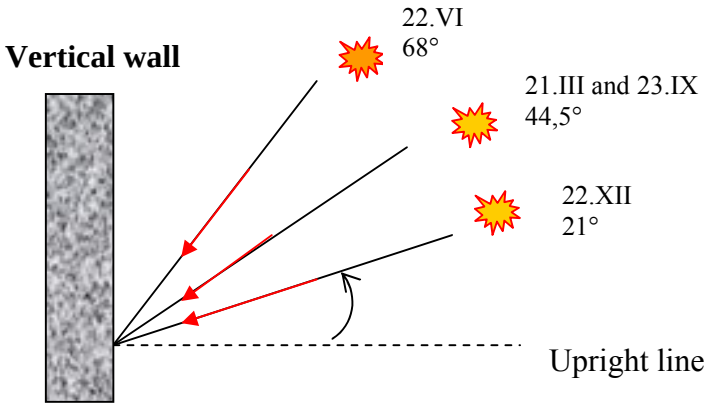

Comparison of temperatures for glass and classic thermal insulators
Temperature °C
25
20
15
10
5
0
1 2 3 4 5 1 2 3 4 5 1 2 3 4 5 1 2 3 4 5 1 2 3 4 5
1. week
2. week
3. week
4. week
5. week
glass
classic


Comparison of temperatures for mix transparent wastes and classic thermal insulators
Temperature °C
25
20
15
10
5
0
1 2 3 4 5 1 2 3 4 5 1 2 3 4 5 1 2 3 4 5 1 2 3 4 5
1. week
2. week
3. week
4. week
5. week
mix
classic

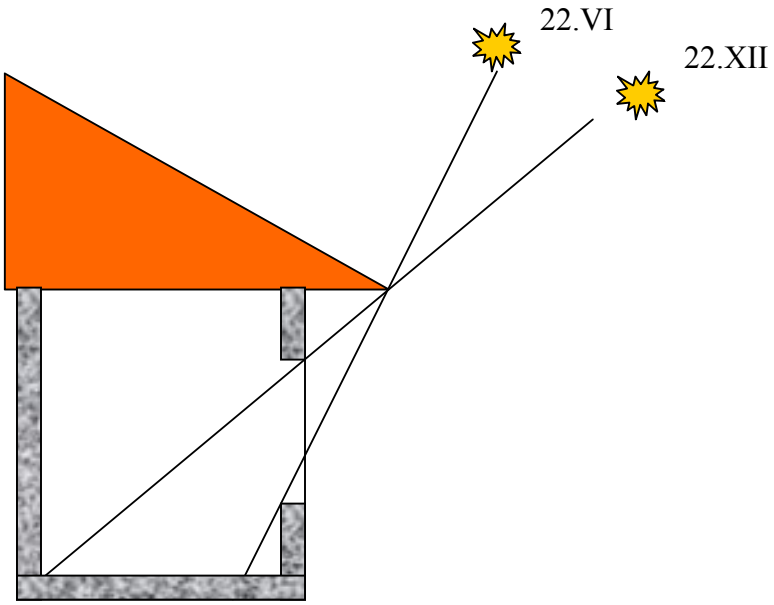

Comparison of temperatures for black plastic bags and classic thermal insulators
Temperature °C
25
20
15
10
5
0
1 2 3 4 5 1 2 3 4 5 1 2 3 4 5 1 2 3 4 5 1 2 3 4 5
1. week
2. week
3. week
4. week
5. week
black plastic bags
classic


Comparison of temperatures for plastic bottles and classic thermal insulators
Temperature °C
30
25
20
15
10
5
0
1 2 3 4 5 1 2 3 4 5 1 2 3 4 5 1 2 3 4 5 1 2 3 4 5
1. week
2. week
3. week
4. week
5. week
plastics bottles
classic

Intensity of global solar emission toward vertical surface turned to the south is much bigger during the winter than that one of summer. Average month energy of global solar emission is much bigger during the summer than that one during the winter due to bigger number of insulation hours. That is very useful for practical use of transparent thermal insulators. During the Equinox 21. III and 23. IX Sun rays fall on the vertical surface with angle of 44, 5°. Sun lights in relation to upright line to the vertical surface turned to the south on 22. XII fall with an angle of 21°, and on 22. VI with an angle of 68°.



Picture 3. An angle of sunlight onto upright vertical surface



Picture 4. Length of canopy

OUR PROJECT KEEPS OUR ENVIRONMENT CLEAN:

1. For normal house, average dimensions of 8mx8mx6m our transparent thermal insulators can clean our environment for 30 000 plastic bottles, as one m^2 of wall covered with this type of insulator takes approximately 300 plastic bottles.
2. At the same time the house of same dimensions can clean our environment through transparent thermal insulators for approximately 100 000 plastic bags.
3. By usage of transparent thermal insulators; needs of woods, coal, and other materials from nature for heating of objects can be reduced for approximately 30%, so we can keep our forests and coal resources present in the future also.
4. As we can reduce needs of woods and coal for heating of object (as transparent thermal insulators keep energy inside the object for a long period, do not let it to go out), at the same time that means we can reduce air pollutants emission, emission of very hazardous gasses and keep our atmosphere clean, healthy for people.
5. Number of people that have serious respiratory organs diseases have also decreased and people have chance for healthier life.
6. Needs for landfills have reduced as transparent thermal insulators clean our environment from some of the main municipal wastes (transparent; plastics, glass, nylon, cellophane, plastic bags, etc.) that make about 30% of wastes.

CONCLUSION:

1. Packing of articles produce big amounts of transparent materials that can be used as raw materials for producing transparent thermal insulators.
2. Transparent thermal insulators can be used in architecture for passive collecting of solar energy and for heating of living spaces.
3. Transparent thermal insulators can be designed as panels colored in different colors and become decorative details on our houses, one type of mosaic.
4. By the usage of transparent thermal insulators; plastics, glass and all other transparent wastes will become useful and our environment will be protected from pollution.
5. By the usage of transparent thermal insulators usage of fossil fuel will be reduced.
6. For the collecting and producing of transparent thermal insulators many new workplaces can be opened and help many poor people to get job and earn some money, and to have better, healthier life.
7. By reduction in the usage of fossil fuels our atmosphere will be protected from air pollution. Global warming would be stopped, climate will become stabilized, earthquakes, floods, hurricanes will become just past events that will not be appearing so often.
8. People will be healthier and people's life will become more beautiful.

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