POLITEKNIK SULTAN SALAHUDDIN ABDUL AZIZ SHAH

REPORT

TITLE :
MUSHROOM FOAM PACKAGING FOR WINE

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JABATAN KEJURUTERAAN MEKANIKAL

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At last but not in least, we would like to thank everyone who helped and motivated us to work on this project.

ABSTRACT

Project 2 is the final year project, FYP for all the Mechanical Packaging Diploma students. The title that we decided for our group is **MUSHROOM FOAM PACKAGING FOR WINE BOTTLE.** The objective of our project is to get reduced the usage of *Polystyrene & Styrofoam*, especially for food & beverage packaging. We found out that Mushroom foam, biodegradable material can solve this problem. A website stated that **"Mushroom Foam Is The New Polystyrene. It Is Biomaterials. Biomaterials Means They Are Sustainable, Non-Polluting And It Also Dissolve Back Into The Earth At The End Of Their Useful Lives"**. If this idea went through the whole world, we can no more see *polystyrene* is produced & used. Mushroom foam can also be replaced with many products that need *polystyrene* like some furniture, some appliances like refrigerator, & at some places inside the car & other automotive. Producing mushroom foam using for mushroom packaging is just a simple & easy stuff. Production method got three processes as stated, firstly, preparing the fill process, next is filling and shaping process and lastly is the drying process. The outcome of our project that we made finally became successful. The mushroom foam block is in the shape as we planned and sketched. In conclusion, we believe that polystyrene can be eradicated in upcoming years by some futuristic and sustainable inventions soon as the world is getting modern day by day. Apart from wine bottle packaging, mushroom can also applied for many products and departments.

ABSTRAK (BAHASA MELAYU)

Projek 2 adalah projek tahun akhir, FYP untuk semua pelajar Diploma Pembungkusan Mekanikal. Tajuk yang kami putuskan untuk kumpulan kami ialah **PEMBUNGKUSAN BUIH CENDAWAN UNTUK BOTOL WINE.** Objektif projek kami adalah untuk mengurangkan penggunaan Polistirena & Styrofoam, terutamanya untuk pembungkusan makanan & minuman. Kami mendapati bahawa buih cendawan, bahan terbiodegradasi boleh menyelesaikan masalah ini. Sebuah tapak web menyatakan bahawa **"Buih Cendawan Adalah Polistirena Baharu. Ia Adalah Biomaterial. Biomaterial Bermaksud Ia Mampan, Tidak Mencemarkan Dan Ia Juga Larut Kembali Ke Bumi Pada Penghujung Kehidupan Bergunanya".** Jika idea ini melalui seluruh dunia, kita tidak dapat melihat polisterin dihasilkan & digunakan lagi. Buih cendawan juga boleh digantikan dengan banyak produk yang memerlukan polistirena seperti beberapa perabot, beberapa peralatan seperti peti sejuk, & di beberapa tempat di dalam kereta & automotif lain. Menghasilkan buih cendawan yang digunakan untuk pembungkusan cendawan hanyalah perkara yang ringkas & mudah. Kaedah pengeluaran mendapat tiga proses seperti yang dinyatakan, pertama, penyediaan proses pengisian, seterusnya proses pengisian dan pembentukan dan terakhir adalah proses pengeringan. Hasil projek kami yang kami buat akhirnya berjaya. Bongkah buih cendawan adalah dalam bentuk seperti yang kita rancang dan lakar. Kesimpulannya, kami percaya polistirena boleh dihapuskan pada tahun-tahun akan datang dengan beberapa ciptaan futuristik dan mampan sebaik sahaja dunia semakin moden dari hari ke hari. Selain daripada pembungkusan botol wain, cendawan juga boleh digunakan untuk banyak produk dan jabatan.

LIST OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1 : INTRODUCTION

1.1 INTRODUCTION

For the project, we are instructed to form a group of 3 people to carry out all the works that related to project till the end of this semester. Objective of this project to figure out & solve the problems for packaging. Also through this project, we can get more futuristic, innovative & sustainability ideas from students as we can applied the effective ideas on packaging process in future.

Project that our group carried out is *"Mushroom Packaging for Wine Bottle"*. Mushroom foam is a biodegradable material which is made up of *flour* & *hemp hurds*. Its characteristics are exactly same as *Styrofoam* & *polystyrene*, which is using for packaging fragile items like glass items, laboratory materials, musical instruments, technological accessories, marble, tiles, porcelains optical instruments. But, *styrofoam* & polystyrene are not biodegradable & both of them produced using several chemicals. Mushroom foam also have some additional advantages compared to *Styrofoam*.

Diagrm 1.1 : Packaging of wine using polystyrene box

1.2 BACKGROUND OF THE PROJECT

Our group had decided the project title after 3 of us had read an article about, disadvantages of using *polystyrene* for packaging & any other purposes. Its very bad for both health & environment. That article also stated that *polystyrene* takes more than 500 years to decompose. It shows that it makes a huge volume of junks & wastes left on world and it will require a separate space to keep away from society.

Diagram 1.2 : Polystyrene wastes that doesn't decomposed yet

Moreover, *Styrofoam* & *polystyrene* are also dangerous to human health. We had found out that putting hot foods & drinks on *polystyrene* and consuming it later causes a really dangerous effects for health. The heat from the food & drinks will breakdown *carcinogen* & *neurotoxin* from the *polystyrene* and mixed up with the foods we consuming it. It may cause those toxins getting absorbed to our bloodstream & tissues.

After that, we decided to carry out a survey as we want to know whether the society is known about the side effects of using polystyrene & Styrofoam or not. Almost 93.5% of people who made response on my poll stated Yes, which means they knew that polystyrene is bad for the environment. And the remaining 6.5%, as they stated No, they doesn't know about polystyrene. This shows that the polystyrene & Styrofoam matter should take it as serious by creating a new material which is danger for the health & environment.

While we looking & searching a solution for it, we got an information, which is Dell Inc. got used Mushroom Packaging for replacing polystyrene to get packaging their computers accessories & laptops. After read the article, we planned to apply this idea for the any food packaging that uses polystyrene as packaging material. And finally, we decided to do this packaging idea for wine because we can do the mushroom foam for wine bottle as secondary packaging, which is not directly make physical contact with the product.

1.3 PROBLEM STATEMENT

1. *Polystyrene* isn't suitable for packaging all the products including foods. Even though manufacturers using for packaging food & beverages, it should be secondary packaging or tertiary packaging. They should not use *polystyrene* for primary packaging because as its very injurious to our health. We should not use *polystyrene* plates & cups for consuming hot foods & hot drinks.

2. Although using *polystyrene* for packaging products rather than foods & drinks are fine, its still gives us a lot of trouble. As said earlier, it will took more than 5 centuries to get decomposed. Only achievements & useful things for the future should be relied upon, not garbage & junk wastes.

3. The pollution caused by polystyrene & Styrofoam is getting horrible day by day. A 1986 EPA report stated that '*polystyrene* manufacturing process is the fifth largest creator of hazardous waste in the United States'. They may only stated for United States, but that's what actually happening around the whole world.

1.4 OBJECTIVES OF THE PROJECT

1. To reduce the usage of *polystyrene* & *Styrofoam* usage, as some manufacturers where the using *polystyrene* & *Styrofoam* more for their products packaging.

2. To get a safety packaging for foods & beverages, despite getting health problems by still using *polystyrene* & *Styrofoam.*

3. Introducing an effective, biodegradable & futuristic material to the packaging industry, which is Mushroom Packaging. It can also be first step of stop using plastics, polystyrene & other bad effective materials completely.

1.5 PROJECT SCOPE

As we searching for which food & beverages packaging is not safe & suitable, the product that we found is wine. Wine is an alcoholic drink which is made from fermented grape juice. Different varieties of grapes produce different styles of wine. Most of the manufacturer's primary tier packaging for it is glass bottle. The approximate height of the bottle will be 14 inches & 3.5 - 4 inches diameter for that bottle. The manufacturers pack secondary tier packaging for the wine using corrugated box or polystyrene box.

Diagram 1.3 : Some of the packaging wine bottles using corrugated box

Packaging a glass bottle inside a cardboard box isn't perfectly safe at all & the bottle might be broken if it was fallen down from somewhere even though it was packaged & the content might get leaked out as the cardboard can absorb liquids a bit. Therefore, packaging the bottle using the *polystyrene* box is the safest one. Although the bottle had done the leakage, the content which is wine couldn't get leaked out from the packaging. But that's also not the perfect material for packaging, because of the *polystyrene* can be harm for the nature & society's health.

1.6 SUMMARY

Polystyrene gives very bad effects for the environment, especially using for packaging food & beverages. It's really bad for health if using *polystyrene* for eating hot food. *Polystyrene* & *Styrofoam* also does marine pollution. A recent research in United States during 2006 stated that every square mile of ocean hosts 46,000 pieces of floating plastic. Almost 30-50% of it are *Styrofoam* & *polystyrene*. After looking at the result of these researches, we all need to pay some attention to this problem. Apart

from that, governments & all the environment caring organizations also should give a little attention to this problem, and try to get any solution for this problem.

CHAPTER 2 : LITERATURE REVIEW

2.1 INTRODUCTION

In this chapter, will be shown some information about *Styrofoam* & *polystyrene*, and also introducing mushroom foam. *Polystyrene* is a synthetic aromatic hydrocarbon polymer & it is made from the monomer known as *Styrene*. *Polystyrene* can be solid or foamed. The foam state is called as *Styrofoam*. General-purpose *polystyrene* is clear, hard, and rather brittle. Most of the fragile products like glass items, laboratory materials, musical instruments & technological accessories are being packed on box together with *polystyrene* inside it to prevent getting any vibration that might bring any effects to the products.

Apart from food packaging, many of the manufacturers will go for *polystyrene* to using it as packaging material because it is really a lightweight material and its also easily can be lifted. By this they can export even more loads than normally they do for each time and that can save their costs for transportation. The next reason is polystyrene is a water resistant, so that many manufacturers will go for it and also prefer it for the new business starters. Its not like corrugated cardboard boxes, which could get damaged if there's raining during transportation or storage. That's why corrugated boxes packaging using plastic films to cover it fully. Thirdly, *polystyrene* needs short period & low cost to produce. This is another reasons why manufacturers still considering *polystyrene* is the best material for packaging. That is why *polystyrene* is labelled as multi-functional material.

2.2 PREVIOUS RESEARCHES / REVIEWS

Although *polystyrene* gives this much of benefits to industrial & safeness to the products, its very bad for the environment, especially using for food & beverages. During the manufacturing of *polystyrene*, over fifty chemical products are released , It can contaminating the air, water and communities those are live near these facilities. *Styrene*, which is used to make polystyrene is believed to be a carcinogen (cancer causing) by the Department of Health and Human Services and the International Agency for Research on Cancer. Irritation of the skin, eyes, the upper respiratory tract, and the *gastrointestinal* tract will be caused by exposure to *Styrene* if the usage of *polystyrene* is keep continued. Chronic exposure results in more severe effects including depression, headaches, fatigue, weakness, hearing loss, and disrupted kidney function.

It is too bad to consume hot foods & drinks from the *polystyrene*.The heat from it cause the chemical from the *polystyrene* to come out & mixed with the foods that we consume. We should avoid consuming few drinks from *Styrofoam* cups like lemon tea, coffee with dairy cream, fruit juices, alcoholic beverages and wine . Red wine will instantly dissolve the *Styrene* monomer that being breakdown from *Styrofoam* cups. In terms of food, we shouldn't eat oily foods from *Styrofoam*

containers or plates. Canadian Food Inspection Agency also recently stated that there are some plastics which shouldn't put inside microwave oven and polystyrene is also included together with the list of some type of plastics.

Diagram 2.1 : Polystyrene cups & plates

The manufacturing of *polystyrene* requires the use of hydrocarbons such as *Styrene* and *benzene*. These hydrocarbons are released into the air and react with nitrogen oxides to produce ground-level ozone, a hazardous air pollutant. Ground-level ozone can impair lung function and lead to respiratory illness. *Polystyrene* is slow to degrade, and if disposed of improperly, the foam can leach chemicals into the environment harming water sources. *Polystyrene* manufacturing is an enormous creator of hazardous waste. Furthermore, *polystyrene* manufacturing greatly contributes to global warming.

To avoid the usage of *Styrofoam*, mushroom foam is the perfect solution for it. Mushroom foam's characteristics & functions are exactly like *Styrofoam* & *polystyrene,* but that is 100 percent biodegradable and renewable material that can be decomposed directly in by nature. While creating *polystyrene* needs combination of chemicals like ethylene & benzene, but mushroom foam just needs 2 ingredients, which are *hemp hurds* & *flour*. *Hemp hurds* also are referred to as *shives*, or *hemp wood. Hemp hurds* are an agricultural product that's produced from hemp. *Hemp hurds* are the woody inner parts of the *hemp stalk*. They are broken into fragments and separated from the fiber by breaking and *scutching* them. *Scutching* may be a process that helps separate the impurities from the raw materials and may be done either by hand of by a machine called a *scutcher.*

Diagram 2.2 : Hemp Hurds

2.3 SUMMARY

Based on the review, although *Styrofoam* gives manufacturers low cost, low duration to get prepared and also weighs very low, if its not suitable for the environment & human, it should not been proceeded. There can be no solution for this issues as long as there are selfish businessmen in the world when they just looking for their profit. Mushroom foam is such an effective way to get rid of the pollution that is caused by *polystyrene & Styrofoam*. Using it wouldn't cause any problem for the nature or to the human race.

CHAPTER 3 : METHODOLOGY

3.1 INTRODUCTION

Producing mushroom foam using for mushroom packaging is just a simple & easy stuff. Producing it needs only *flour* & *hemp hurds*, and must complete three processes. Those processes are Fill preparing process, Filling & shaping process and finally Drying process. Fill preparing process took just 30-40 minutes, and then Filling & shaping process will be carry on after 4-5 days of fill prepared. The last process, which is Drying process need only 2-3 hours. For it, we should wait for 5-6 days after completing Filling & shaping process. Its placing the mixture inside microwave oven.

3.2 PROJECT DESIGN

We had an idea to produce the whole box from mushroom foam & doesn't need to use cardboard box as secondary packaging. But producing mushroom foam needs a longer period of time, approximately like 5-7 days. So, doing large volume of it could took more time than that. Because of that we planned to do mushroom as a holder at the top & bottom inside a packaging box. Mushroom foam is placing like this can control any vibration that is occur if the box packed in fell down. It wouldn't make the product get damage even though the cardboard box got damaged. The diagram below clarifies how the packaging would be like after putting the both of mushroom foam inside the box.

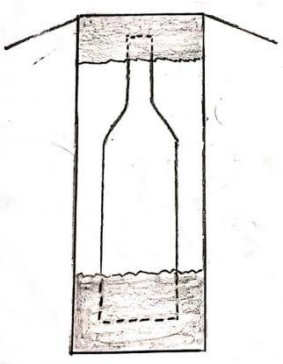

Diagram 3.1 : Side view of product packaging

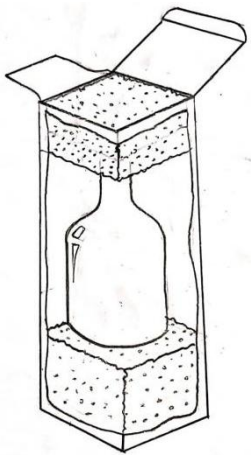

Diagram 3.2 : Isometric view of product packaging

We need two parts of mushroom blocks made up of mushroom foam for our project, the first one is the bottom part. It should be placed at the bottom inside the box before putting the product inside the box. We also sketched a hole in cylindrical shape where, the mushroom foam can hold the product while transportation. The second part of the mushroom foam is should be placed at the top of the bottle after putting it inside the box. That will protect the bottle getting out from the box also it will prevent the bottle from getting any damages due to the vibration while transporting. By making box like in the diagram below, we can save time & cost rather than producing a full box made up of mushroom foam.

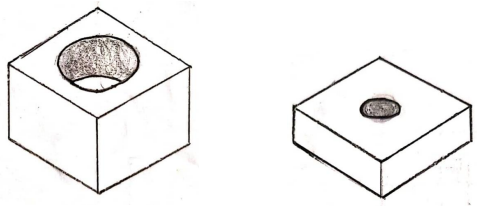

Diagram 3.3 : Mushroom blocks

Cost for this mushroom foam is not too high. It is because only material manufacturers need to buy is flour & Hemp hurds. And, looking for those items also not too hard because it can get from distributors & sellers who selling mushroom kit or bag. Mushroom bag are usually used to produce mushrooms. Based on our research, one mushroom bag is enough for producing mushroom foam packaging for wine bottle. Apart from that, there's no high cost material, chemical materials & toxic materials. We use few things like plastic bags, microwave oven & containers. Those things are suitable for only using at home. Manufacturers usually need to produce large amount of mushroom foam & these things are not perfect to use at factories & industries. So that, manufacturers can change the items that mentioned before so that it can save their cost & time.

3.2.1 PROJECT PRODUCTION METHODS / PROCEDURES

Production method got three processes as stated before. Its not too hard to produce mushroom block. If all the steps followed correctly, then can prepare mushroom block perfectly.

1. <u>Part A (preparing the fill process)</u>

a) The things all needed were prepared.
b) Some *hemp hurds* put inside a plastic bag.
c) Pome flour poured inside a mixing bowl.
d) More water were filled at the mixing bowl & the mixture stirred well.
e) Finally, the mixture was poured inside the the plastic bag, which is filled with *hemp hurds*.
f) The plastic bag was tied as no air flowing inside it. Then, it was placed at the place there's no any direct sunlight contact for 4-5 days.

Diagram 3.4 : Mixture of *hemp hurds* & *flour*

2. <u>Part B (Filling & shaping process)</u>

a) After 4-5 days, the mixture was took out from the plastic bags.
b) It was poured inside mixing bowl. Then, some flour is added to the mixing bowl & mixed together.
c) The mixture put inside the tray that using to cast the block shape, and the top of the tray is covered with plastic sheet.
d) Poke 4-6 holes at the plastic sheet using thumbtacks or needles to allow some air exchange.
e) Put the container at any cool or place for 5-6 days.

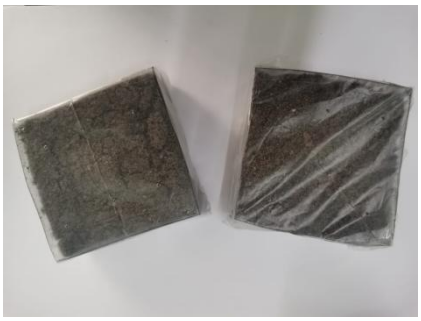

Diagram 3.5 : After Filling & Shaping Process

3. <u>Part C (Drying process)</u>

a) That part is removed from the tray slowly & carefully, and it should be put on cool & dry place for 1-2 days to letting it dried in open air.
b) The microwave oven is preheated at 93°C (200°F) for 30 minutes.
c) Finally, the part is placed at oven till it fully dried & became hard.

Diagram 3.6 : After getting heated at oven

3.2.2 MATERIALS AND EQUIPMENT

Things that we need :-

1. Hemp hurds

2. Flour

3. Tray (the one in block shape)

4. Plastic Bags (better if it's transparent)

5. Water Spraying Bottle

6. Tape or Rubber Band

7. Medical Gloves

8. Mixing Bowl

9. Microwave Oven

3.2.3 DATA ANALYSIS METHODS

At the beginning, we completed Part A procedure which is the filling preparing process.In this process we mixed the hemp hurds together with a mixture of flour and some water. By doing this, the *Ganoderma lucidum* from the mixture will build a strong base for mushroom foam because it is one of the popular choice for Mycelium Architecture. Mycelium is the vegetative part of a fungus or fungus-like bacterial colony, consisting of a mass of branching,

thread-like hyphae. Mycelium is also well known for mushroom forming. Fungal colonies composed of mycelium are found in and on soil and many other substrates.

The next one is Part B, which is filling and shaping process. For this process, we should wait for 4-5 days from completing Part A process. In this part, we will mix the flour into the mixture and placing inside the tray without adding water. Mixing by this will make flour getting attached & merged with the mixture (hump herds & *Ganoderma lucidum*). This will also make the product became hard & stronger.

And finally, the last part of making mushroom foam. At the beginning of this part, we will took out the product from the tray and placed at an open air for 1 or 2 days. And lastly, the product is put inside the oven till it fully dried. It will make all the moisture from the product will get away.

3.3 SUMMARY

Producing mushroom foam is not too hard to do. We can do it easily if we have microwave oven in our home. The apparatus & materials we need for it also can be easily get on the mini-markets & supermarkets. The materials for making mushroom foam are also not high reactive like the chemicals used to make *Styroam* & *Polystyrene*, because different type of gases are being released while making it.

The only thing that is hard to get while making mushroom foam is *hemp hurds* or also known as sawdust. Hemp hurds can be easily get on the woodworking places. The woodworkers can store the dusts they getting while doing all the woodwork and can get some income by selling it. We also got the *hump herds* from one of the woodworkers from Klang. Even for the *hump herds*,we didn't go far away from home to get it. All the apparatus & materials are easily can be get.

CHAPTER 4 : RESULTS OF DATA ANALYSIS AND DISCUSSION

4.1 INTRODUCTION

Every ideas & projects that carrying over needs response from the society, to check out whether is this project is acceptable for them or not. By this, we can also get confirmed that this idea is suitable & perfect or not. Another additional advantage we can get from survey is we can also receive many suggestions from the society which can be helpful for our project and some information we may didn't know & problems that we didn't aware from this project.

Our group had conducted the survey through Google Form. We done the survey by this because, recently the whole global is obsessed by the pandemic, named *Covid-19*. A virus named *Corona* is the main reason how this pandemic is getting worse day by day. Huge amount of people are getting sick & died around the world daily. Its really dangerous for unhealthy peoples & whose antibody isn't stronger as normal. To prevent we all getting sick, we must not go outside & get contacting with other peoples. That's the reason why we conducted the survey like this.

We conducted the survey through *Google Form* also because of it can save time & cost. Survey on *Google Form* can be produced by just typing the questions all at computer or mobile phone & after created it, we can just share the link on social media platform like *WhatsApp*, *Facebook*, *Instagram*, *Telegram*, *Twitter* & many more. By sharing at these platforms, it can reach to the many people who are active on it. We also doesn't need to spend time to for asking people to stating their opinion like going to public places, printing survey forms & asking peoples to fill it. We can just share the link & continue with the other works that need to done. While we are free, we can just check number of response received from *Google Drive*. *Google* having this wonderful service which can be useful for students, office workers & organizations.

4.2 PROJECT FINDINGS & OUTCOMES

In our survey, we had put 6 questions to ask all of them are multiple choice questions. All of them are like that because it wouldn't took long time of period to fill. The survey had responded by 31 people. Tables & diagram below shows the questions & response for it.

QUESTION 1 Do you working at places like shops, stall, restaurant or does your family doing any business? **(31 Responses)**	
	Yes **(45.2%, 14 people)**
	No **(54.8%, 17 people)**

Table 4.1 : Question 1 & two options on survey

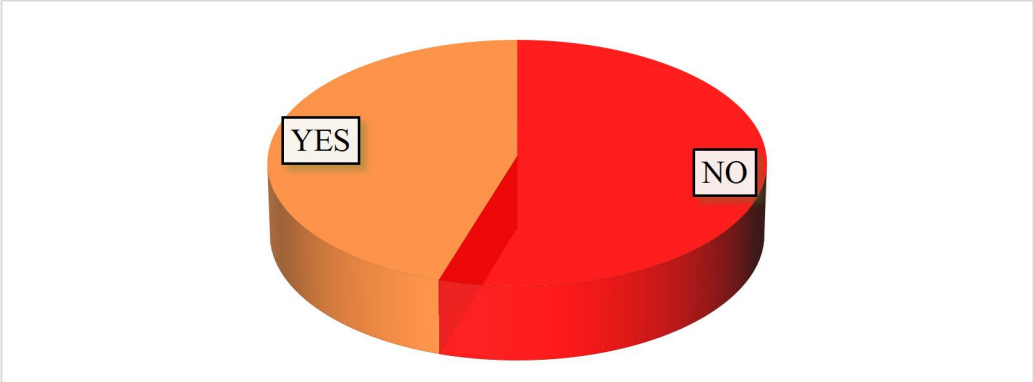

Diagram 4.1 : Pie chart for the responds that respondents made for Question 1

QUESTION 2 In scale of 10 products you buying at shop or market, how many of it are packed with *polystyrene*? **(31 Responses)**	
	1-3 products **(61.3%, 19 people)**
	4-6 products **(29.0%, 9 people)**
	7-9 products **(6.5%, 2 people)**
	All the 10 products **(3.2%, 1 people)**

Table 4.2 : Question 2 & four options on survey

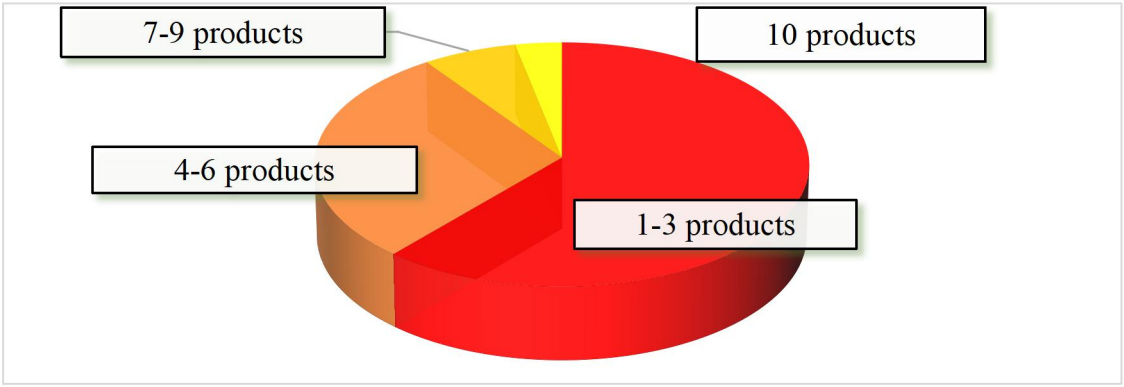

Diagram 4.2 : Pie chart for the responds that respondents made for Question 2

QUESTION 3 For the 5 occasions you attending, how many organizers uses plates & cups that are made up of *polystyrene*? **(31 Responses)**	
	1-2 occasions **(48.4%, 15 people)**
	3-4 occasions **(35.5%, 11 people)**
	5 occasions **(15.1%, 5 people)**

Table 4.3 : Question 3 & three options on survey

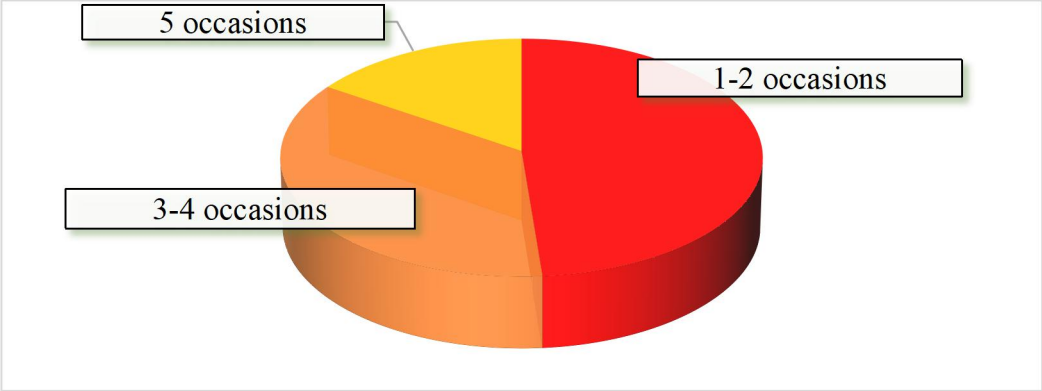

Diagram 4.3 : Pie chart for the responds that respondents made for Question 3

QUESTION 4 ***POLYSTYRENE* MANUFACTURING PROCESS IS THE 5TH LARGEST CREATOR OF HAZARDOUS WASTE IN THE USA**". Do you think *polystyrene* is that level of dangerous for the environment? **(31 Responses)**	
	Yes, of course **(93.5%, 29 people)**
	I think so No **(6.5%, 2 people)**

Table 4.4 : Question 4 & two options on survey

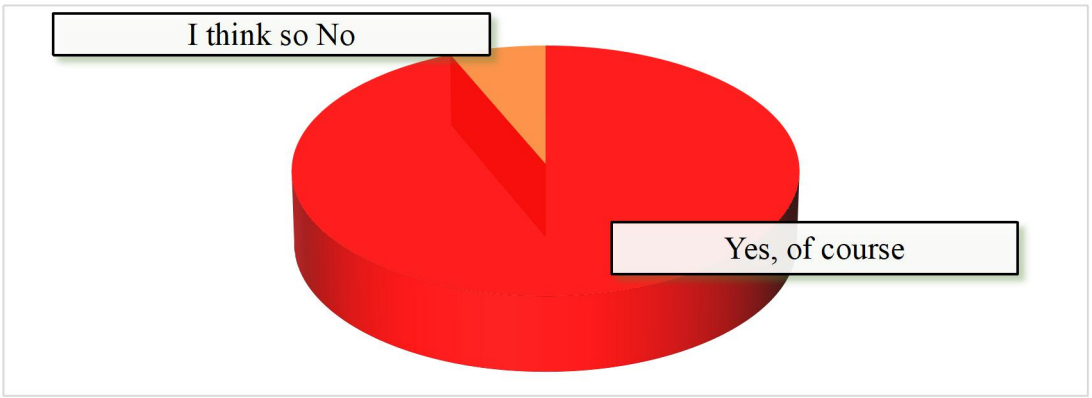

Diagram 4.4 : Pie chart for the responds that respondents made for Question 4

QUESTION 5 Using *polystyrene* for packaging is not good & can cause problems for the which products? **(31 Responses)**	
	Electronic Accessories **(3.2%, 1 people)**
	Food & Beverages **(58.1%, 18 people)**
	Non-fixed Furniture **(9.7%, 3 people)**
	Cookery items (meat, poultry & eggs) **(29%, 9 people)**

Table 4.5 : Question 5 & four options on survey

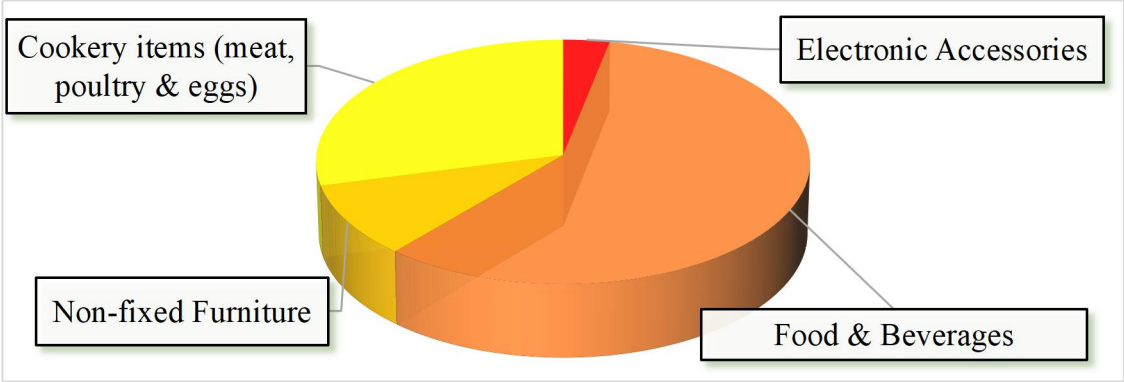

Diagram 4.5 : Pie chart for the responds that respondents made for Question 5

QUESTION 6 **"MUSHROOM FOAM IS THE NEW *POLYSTYRENE*. IT IS BIOMATERIALS. BIOMATERIALS MEANS THEY ARE SUSTAINABLE, NON-POLLUTING AND IT ALSO DISSOLVE BACK INTO THE EARTH AT THE END OF THEIR USEFUL LIVES."** If mushroom foam is used alternatively for *polystyrene*, do you show your support for the manufacturers? **(31 Responses)**	
	Yes, I will **(87.1%, 27 people)**
	No, I would prefer *polystyrene* **(12.9%, 4 people)**

Table 4.6 : Question 6 & two options on survey

Diagram 4.6 : Pie chart for the responds that respondents made for Question 6

4.3 DISCUSSION

On our survey, almost 94% of respondents knew about the bad effects of *polystyrene*, this may because nearly half of the respondents are working or owning a shop, stall or restaurant. We found it by the response on the Question 1. That question shows us that about 45.2% respondents are working or owning a shop & the remaining 54.8% are consumers. By this survey, we also came to know that *polystyrene* doesn't used more for occasions as majority of respondents chose only 1-2 occasions are using polystyrene plates & cups out of 5 occasions. We also asked a question that polystyrene is not good for which product's packaging. About 58% of

people chosen food & beverages, and followed by cookery items like meat, poultry & eggs. It shows that *polystyrene* is not suitable packaging material for products which are related to food & cookery items. We asked the final question, to check out that the society is ready to accept the mushroom foam or not. About 27 people from 31 are preferring mushroom foam and the remaining 4 would still stick with the *polystyrene*. That 4 of them are maybe businessmen, and they preferring *polystyrene* because they might felt *polystyrene* is more better than mushroom foam. This survey fully concludes that around 70-80% of respondents are aware of *polystyrene's* bad effects.

4.4 SUMMARY

Using mushroom foams for packaging can cause some advantages & disadvantages. The first advantage is it's 'biodegradable'. This one is biodegradable because easily can be grown from agricultural waste products which are plentiful. Apart from that, it also requires just less energy to fabric and then, the its process also wouldn't create any pollution & wouldn't let any wastes left.

The second benefit of mushroom foam for packaging is the quality of it. The mushroom foam is mouldable, weighs light & also stronger than *Styrofoam.* It's also a water-resistant material like styrofoam, but the thing that make mushroom foam better than *polystyrene* is it can resist fire. *Polystyrene & styrofoam* will shrunk and will melt down when heated or exposed to fire. And, nothing would happen to mushroom if the same matter happens to it. Only the surface of it only will get dark.

The only disadvantage of using mushroom foam for packaging is the time taken for making it. Duration for producing mushroom foam will took approximately 12-14 days. It is higher period than producing most of the plastics & *polystyrene*. This will save time & cost for the manufacturers. That is the reason for most of them goes for *polystyrene & Styrofoam*.

CHAPTER 5 : CONCLUSION AND RECOMMENDATIONS

5.1 INTRODUCTION

From this project, our group had learned more about mushroom foam and *polystyrene.* We have doing this project since the start of the Study Week 2. We had done researches since then, many unknown facts & information were we getting known from that. Like, dangerous for health if using *polystyrene* plate & cups to consume hot foods & drinks. Many people didn't know about this & some eating hot foods on that till now. Even we also had done this before. After getting know that this is not good for health, we all will make our best to reach this information to our family & friends. Like this information, our group get to know so many unknown facts like this.

Diagram 4.1 : Polystyrene plate that carrying food

5.2 CONCLUSION

Throughout this project, we believe that *polystyrene* can be eradicated in upcoming years by some futuristic & sustainable inventions soon as the world is getting modern day by day. While searching for the project, we had found many interesting & multifunctional invention on the internet. We also seen many solutions for currently facing problems even currently. So, just predict how many ideas could be there in future. By this, we are 100% believing that we can see many inventions & solutions for *polystyrene.*

5.3 RECOMMENDATIONS

Mushroom foam not only can be used in packaging. It can be used in many products & many departments, like applying on some electronic appliances which uses polystyrene such as refrigerators, vacuum cleaner, air conditioners, ovens, microwaves, blenders and many more. In refrigerator, *polystyrene* is placed inside it to prevent the coldness getting out from refrigerator. Because of mushroom foam also having the same characteristics like *polystyrene,* it can also placed inside refrigerator.

A top quality refrigerator can be used for 15-20 years. A 20 year product doesn't need to put a 500 year non-composeable material.

Diagram 4.2 : Refrigerator

Mushroom foam can also been used inside car & the other automotive like van, lorry & bus. It can be applied inside where the *polystyrene* is applied same as electronic appliances. Inside automotive, mushroom foam can be applied inside soft door trim, instrument panels, dashboard, steering & interior rooftop. Apart from that, *polystyrene* is also inserted inside furniture like bed & sofa. *Styrofoam* is also used widely inside child protective seat. Therefore, mushroom foam can also been applied to these things.

Diagram 4.3 : Inside car accessories

5.4 SUMMARY

Polystyrene & other type of plastics like *thermoplatics* ***(polypropylene, polyethylene, polyvinylchloride, polystyrene, polyethylenetheraphthalate, polycarbonate)*** should be stop using by the consumers and also stop manufacturing & producing by the manufacturers. These thermoplastics are using to produce sports equipment, toys like Lego blocks, shampoo bottles, grocery plastic bags & many more. There are some corporate & companies who are stopped using thermoplastics & started using eco-friendly packaging. For an example, plastic bags are now replaced with biodegradable plastic bags, which are made from plants & can be composted. Plastic bottles bottles also been replaced with paper bottles, as Coca-Cola recently had done trials for first ever paper bottle, which was done by a Danish firm paper bottle company named Paboco.

Some other branded companies should also do the packaging which is good for nature & environment. Mushroom foam is an effective & futuristic material, it might be the seed of solution for this materials like, polystyrene & other thermoplastic materials which are made up of chemical mixtures. These materials are polluting the nature. The only beauty of this universe is the creatures in the world. Those are getting polluted & facing extinction.

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ATTACHMENTS

ATTACHMENT A	Questionnaire
ATTACHMENT B	List of Respondents

ATTACHMENT A : QUESTIONNAIRE

MARKET SURVEY FOR THE SOCIETY'S THOUGHTS ABOUT POLYSTYRENE

This survey is conducted investigate people's opinion about polystyrene. My final year project is based on Packaging Principles/Concepts, Development, Design, Sustainability & Improvement

1. Do you working at places like shops, stall, restaurant or does your family doing any business?

□ Yes
□ No

2. In scale of 10 products you buying at shop or market, how many of it are packed with polystyrene?

□ 1-3 products
□ 4-6 products
□ 7-9 products
□ All the 10 products

3. For the 5 occasions you attending, how many organizers uses plates & cups that are made up of polystyrene?

□ 1 & 2 occasions
□ 3 & 4 occasions
□ 5 occasions

POLYSTYRENE MANUFACTURING PROCESS IS THE 5TH LARGEST CREATOR OF HAZARDOUS WASTE IN THE USA

4. Do you think polystyrene is that level of dangerous for the environment?

□ Yes, of course
□ I think so no

5. Using polystyrene for packaging is not good & can cause problems for the which products?

□ Electronic Accessories
□ Food & Beverages
□ Non-fixed Furniture
□ Cookery items (meat, poultry & eggs)

MUSHROOM FOAM IS THE NEW POLYSTYRENE. IT IS BIOMATERIALS. BIOMATERIALS MEANS THEY ARE SUSTAINABLE, NON-POLLUTING AND IT ALSO DISSOLVE BACK INTO THE EARTH AT THE END OF THEIR USEFUL LIVES

6. If mushroom foam is used alternatively for polystyrene, do you show your support for the manufacturers?

□ Yes, I will

□ No, I would still prefer polystyrene

ATTACHMENT B : LIST OF RESPONDENTS

NO.	TIMESTAMP	Q1	Q2	Q3	Q4	Q5	Q6
1.	2021/05/26 21:36:17	NO	4-6	3 & 4 OCCASIONS	YES, OF COURSE	B	YES
2.	2021/05/26 21:36:17	YES	1-3	5 OCCASIONS	YES, OF COURSE	B	YES
3.	2021/05/26 21:36:59	NO	1-3	1 & 2 OCCASIONS	YES, OF COURSE	B	NO
4.	2021/05/26 21:38:15	NO	4-6	3 & 4 OCCASIONS	YES, OF COURSE	A	YES
5.	2021/05/26 21:39:23	NO	1-3	1 & 2 OCCASIONS	YES, OF COURSE	B	YES
6.	2021/05/26 21:41:10	YES	1-3	3 & 4 OCCASIONS	YES, OF COURSE	B	NO
7.	2021/05/26 21:41:54	YES	1-3	1 & 2 OCCASIONS	YES, OF COURSE	C	YES
8.	2021/05/26 21:42:28	YES	1-3	3 & 4 OCCASIONS	YES, OF COURSE	B	YES
9.	2021/05/26 21:43:43	NO	4-6	5 OCCASIONS	I THINK SO NO	D	YES
10.	2021/05/26 21:53:59	NO	4-6	5 OCCASIONS	YES, OF COURSE	B	YES
11.	2021/05/26 21:55:36	NO	1-3	1 & 2 OCCASIONS	YES, OF COURSE	D	YES
12.	2021/05/26 21:55:37	YES	ALL 10	5 OCCASIONS	I THINK SO NO	D	NO
13.	2021/05/26 22:01:44	YES	1-3	1 & 2 OCCASIONS	YES, OF COURSE	B	YES
14.	2021/05/26 22:02:58	YES	4-6	3 & 4 OCCASIONS	YES, OF COURSE	B	YES
15.	2021/05/26 22:04:04	YES	1-3	1 & 2 OCCASIONS	YES, OF COURSE	D	YES
16.	2021/05/26 22:11:10	NO	1-3	5 OCCASIONS	YES, OF COURSE	D	YES
17.	2021/05/26 22:11:30	NO	1-3	3 & 4 OCCASIONS	YES, OF COURSE	B	YES
18.	2021/05/26 22:17:41	NO	1-3	3 & 4 OCCASIONS	YES, OF COURSE	D	YES
19.	2021/05/26 22:29:20	YES	4-6	1 & 2 OCCASIONS	YES, OF COURSE	B	NO
20.	2021/05/26 22:32:54	NO	1-3	1 & 2 OCCASIONS	YES, OF COURSE	B	YES
21.	2021/05/26 22:37:06	NO	1-3	1 & 2 OCCASIONS	YES, OF COURSE	B	YES
22.	2021/05/26 22:38:38	YES	1-3	3 & 4 OCCASIONS	YES, OF COURSE	C	YES
23.	2021/05/26 22:45:36	NO	1-3	1 & 2 OCCASIONS	YES, OF COURSE	D	YES

24.	2021/05/26 22:47:46	NO	4-6	3 & 4 OCCASIONS	YES, OF COURSE	B	YES
25.	2021/05/26 23:09:12	YES	4-6	3 & 4 OCCASIONS	YES, OF COURSE	B	YES
26.	2021/05/26 23:13:11	YES	7-9	3 & 4 OCCASIONS	YES, OF COURSE	B	YES
27.	2021/05/26 23:30:45	NO	1-3	1 & 2 OCCASIONS	YES, OF COURSE	B	YES
28.	2021/05/27 00:35:26	NO	4-6	1 & 2 OCCASIONS	YES, OF COURSE	D	YES
29.	2021/05/27 13:25:53	NO	1-3	1 & 2 OCCASIONS	YES, OF COURSE	B	YES
30.	2021/05/27 15:01:02	YES	7-9	1 & 2 OCCASIONS	YES, OF COURSE	D	YES
31.	2021/05/27 18:47:21	YES	1-3	1 & 2 OCCASIONS	YES, OF COURSE	C	YES