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Çalışma Ortamındaki Kökü Kokulara Karşı Tek Kullanımlık Maske Tasarımı

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DISPOSABLE MASK DESIGN FOR ODOR POLLUTION IN THE WORK ENVIRONMENT

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ABSTRACT: Ambient scent is very important for work environment. Scent is so important is due to the vital function of our breathing. People working in a fragrant environment can work much more efficiently. In odor pollution environments, the work desire of employees leads to decrease markedly. Many companies do have a scent apparatus. However, due to the high tempo of intense working conditions and work, companies are not paying attention to this issue. Therefore, 30% of the apparatus are not being used effectively. Odor pollution masks have become preferably those working in such areas. In this study, we determine the discomfort due to bad smell and we have designed a mask in order to reduce inefficiencies. For this purpose liposome microcapsules encapsulating agents have been produced and limonene material was capsulated. These capsules were transferred to nonwoven masks with the polyurethane binder and impregnation process. The performance qualifications such as encapsulation success, presence of core substance and existence of the capsules on the textile surface are determined by SEM, TGA, FT-IR, DSC, GC analyses and particle size measurement. Results show that, limonene encapsulated liposome microcapsules are bounded by chemical bonds to the disposable nonwoven masks.

Key Words: Liposome, limonene, capsule, disposable mask

ÇALIŞMA ORTAMINDAKİ KÖKÜ KOKULARA KARŞI TEK KULLANIMLIK MASKE TASARIMI

ÖZET: Ortam kokusu çalışma alanı ve hayati fonksiyonların en önemlisi olan nefes alma açısından oldukça önemlidir. Güzel kokulu bir ortamda çalışan insanların çok daha verimli çalıştıkları ortadadır. Koku kirliliği bulunan ortamlar, çalışanların iş arzusunun belirgin olarak azalmasına neden olur. Birçok şirket bu amaçla ortam kokusunu düzelten koku aparatlarına sahiptir. Ancak yoğun çalışma koşulları ve çalışma temposunun yüksekliği nedeniyle, şirketler bu konuya dikkat etmemektedir. Bu nedenle, aparatların %30'u etkili kullanılmamaktadır. Koku kirliliği maskeleri bu tür ortamlarda çalışanlar için tercih edilir bir hale gelmiştir. Bu çalışmada, kötü koku nedeniyle oluşan rahatsızlığı ve verimsizliği azaltmak amacıyla bir maske tasarlanmıştır. Bu amaçla kapsüle edici ajan olarak lipozom kapsülleri üretilmiş ve güzel koku veren limon yağı lipozomlar içerisine kapsüllenmiştir. Bu kapsüller, poliüretan bağlayıcılar yardımıyla emdirme yöntemi ile dokusuz yüzey maskelere aktarılmıştır. Kapsülasyonun gerçekleşme durumu ve tekstil yüzeyi üzerinde kapsüllerin varlığının incelenebilmesi amacıyla SEM, TGA, FT-IR, DSC, GC analizleri ve partikül boyut ölçümü yapılmıştır. Sonuçlar, limon yağı içeren lipozomların maskeler üzerine kimyasal bağlar ile bağlandığını ortaya çıkarmıştır.

Anahtar Kelimeler: Lipozom, limonen, kapsül, tek kullanımlık maske

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1. INTRODUCTION

Liposomes encapsulating the active substances are available for carrying the conveyor system from one end to the other end of the cell membrane. Liposomes are closed vesicles with an aqueous interior of the region and they are spherical phospholipid bilayers with 10 nm diameters ranging from 10 mm. Liposomes are not a substance, they are carrier systems [1].

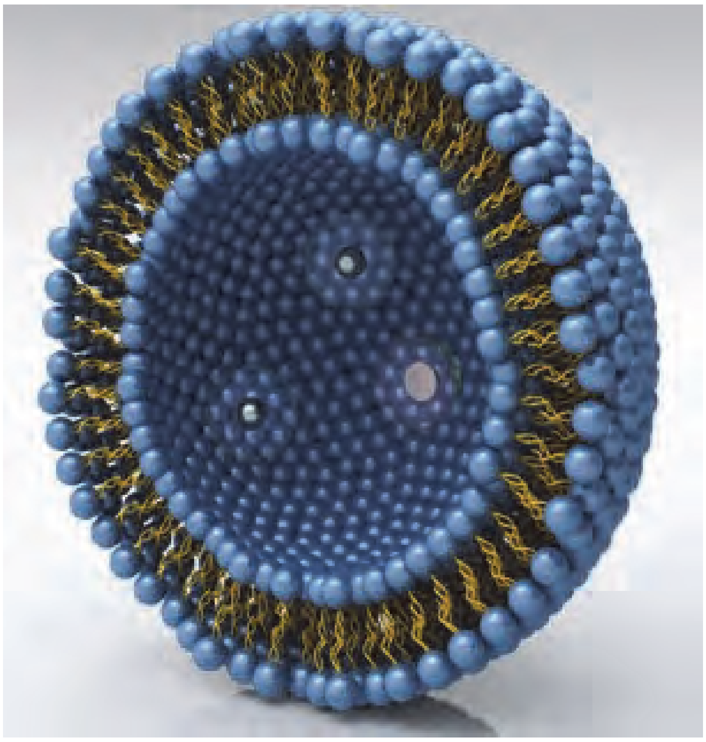


Figure 1. Monolayer Liposome [2]

Liposomes consist of two parts which are hydrophobic and hydrophilic. The hydrophilic portion consists of phosphate groups and choline, hydrophobic parts consist two hydrocarbon chain [3]. Liposomes can be classified according to sizes which are small and large. Also they can be classified according to layers which are monolayer, bilayer and multilayer [4].

Liposomes release the microencapsulated material slowly, promoting a retarding effect, comparable with the one obtained with retarding agents, making them a good alternative to commercial levelling products. Using liposomes in dyeing process gives a more natural handle and improved quality properties to fibers [3,5-11].

On the other hand, limonene obtained from citrus species often highly volatile oil. Because of its pleasant odor and flavorings are widely used in the food and cosmetic ingredients [12].

The aim of this research is we disturbances due to bad smell and we design a mask in order to reduce inefficiencies. For this purpose liposome microcapsules encapsulating agents have produced and capsulated limonene material. These capsules were transferred to nonwoven masks with the polyurethane binder and impregnation process. The performance qualifications such as encapsulation success, presence of core substance and existence of the capsules on the textile surface are determined by SEM, TGA, FT-IR, DSC, GC analyses and particle size measurement.

2. MATERIAL AND METHOD

2.1. Material

In this research, as a mask 100% PET nonwoven fabric is used. The shell materials lecithin and cholesterol is donated kindly from Sigma Aldrich Co. The organic solvent chloroform and ethanol is provided from MERCK for liposome. The other auxiliary chemicals that used in the study are technical graded.

2.2. Method

Within the scope of our other project works which we did before, 10 different liposome varieties were tested for optimal ratio of liposome. For this purpose, on the textile surface are determined by SEM and particle size measurement. Liposome which provides optimum conditions required for the production of lecithin / cholesterol ratio is as Table 1.

In order to obtain liposome, Bangham Method is employed. In this process to form the liposomes, it is utilized capability of limonene with lecithin and cholesterol and specific ratio is solved homogenously in organic solvent. Afterwards, with evaporator machine evaporate the solution from this solvent and obtained the capsules. In a subsequent step, we used two different polyurethane binders and we have applied the capsules to nonwoven masks by impregnation processes. Impregnation of liposome on nonwoven mask are as in Table 2.

Table 1. Optimal Liposome Ratio

PC:CH w/w	PC (lechitin) (gr)	CH (Cholesterol) (gr)	Chloroform (ml)	Ethanol (ml)
9.0-1.0	0,5	0,055	4 ml	2 ml

Table 2. Impregnation of liposome on nonwoven mask

Capsule (g/l)	Binder (g/l)	Pick Up (%)	Drying + Fixation	
			Temperature(°C)	Time (min)
40	50	90	120	7

2.3. Characterization of Liposomes

Particle size distribution test is performed by Zetasizer Nano-S. Aqueous solution of all capsule formulations in the study is putted into disposable cuvettes, separately. With an aid of laser doppler, light is scattered through capsule dispersion. Thus distribution of particles in solution is discovered.

Fourier Transform Infrared Spectroscopy (FT-IR) is used on the purpose of determining encapsulation success with changes on infrared spectrum. In this content, samples are measured at wavelength range of 600-4000 cm^{-1}.

To determine the most efficient capsule formulation, several analyses are done. Morphological features of capsules are detected by SEM images. SEM analysis is carried out at Quanta 250 FEG.

Also thermogravimetric analysis of this capsule is done in order to understand the physical and chemical state changes depend on thermal alteration. Observation of mass change with temperature increase is composed the basis of the analysis. TGA is carried out with nitrogen at range of 0-600 ° C with Perkin Elmer Diamond TG/DTA. Another analysis conducted in order to examine the thermal effects DSC was carried out.

In order to examine the presence of limonene examine GC ((Agilent 6890N, Agilent, USA) analysis was carried out. Samples were desorbed for 10 min at 240 °C using a helium flow at 40 mL/min. Internal trap temperature during sample desorption was kept at 35 °C. The trap was desorbed for 1 min at 240 °C. Then, it was baked for 10 min at 250 °C. A valve oven and transfer line temperature of the thermal desorber was 200 °C. GC/MSD interface temperatures were 230, 150, and 280 °C, respectively. GC/MS was operated at “scan” and “selected ion monitoring” modes simultaneously [13].

3. RESULTS AND DISCUSSION

3.1. Particle Size and Distribution Analysis

When the data is surveyed, it is found that all of the samples are in the size range of 250 nm and the sizes of the capsules obtained a homogeneous distribution. As well as, capsule size is close to each other. So it shows that capsule production successfully carried out.

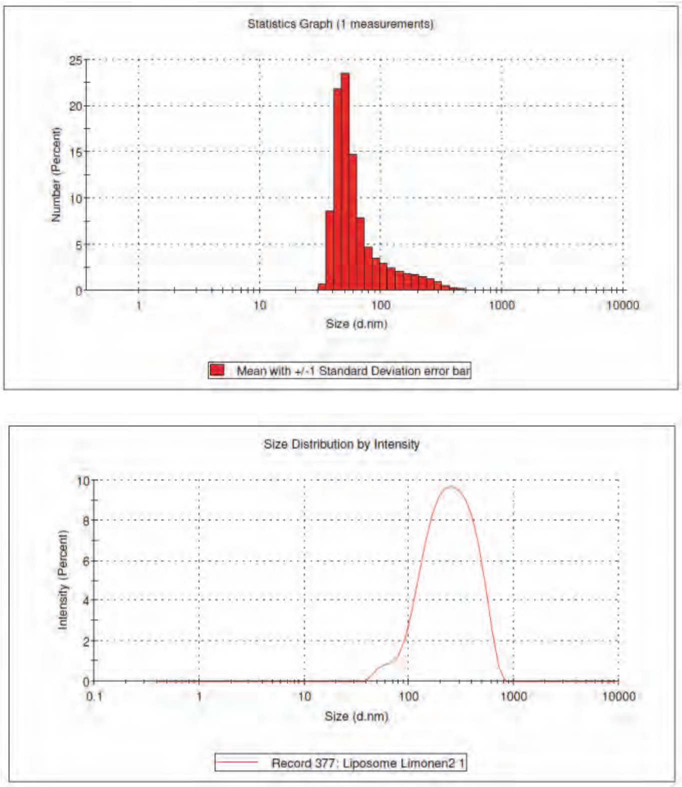


Figure 2. Particle Size Analysis of Limonene Encapsulated Liposome

3.2. Morphological Features

In the scope of the study, to demonstrate the encapsulation success and determine morphological properties of cosmetic capsules, SEM analysis is performed. When the 500 and 1000 times magnified SEM images are evaluated, it is understood that capsules are prepared successfully.

3.3. Fourier-Transform Infrared Spectroscopy

The bands for CH bends appear at approximately 1000 cm^{-1} for the in-plane bend sand at about 675 cm^{-1} for the out-of-plane bend. Spectrum may have an alkyl bromide. Because, it is a relatively simple spectrum with an absorption to the right of 667 cm^{-1}. So liposomes led to occur of new bonds according to FTIR diagrams.

3.4. Thermal Analysis

The thermal behaviours of liposome and its raw materials are presented in Figure 5. Weight losses due moisture of substances is seen at 100ºC. Decomposition is accelerated at 333ºC and the material is fully decomposed at 439ºC for untreated nonwoven mask. When the TGA curve of limonene encapsulated liposome is examined, it is found out decomposition is started 368ºC and the material is fully decomposed at 458ºC.

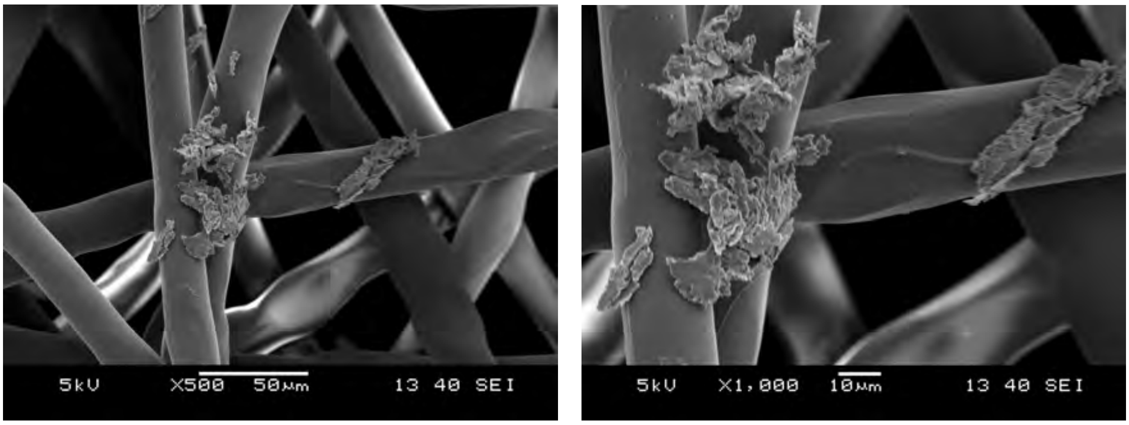


Figure 3: SEM Images of Liposome-Impregnated Mask

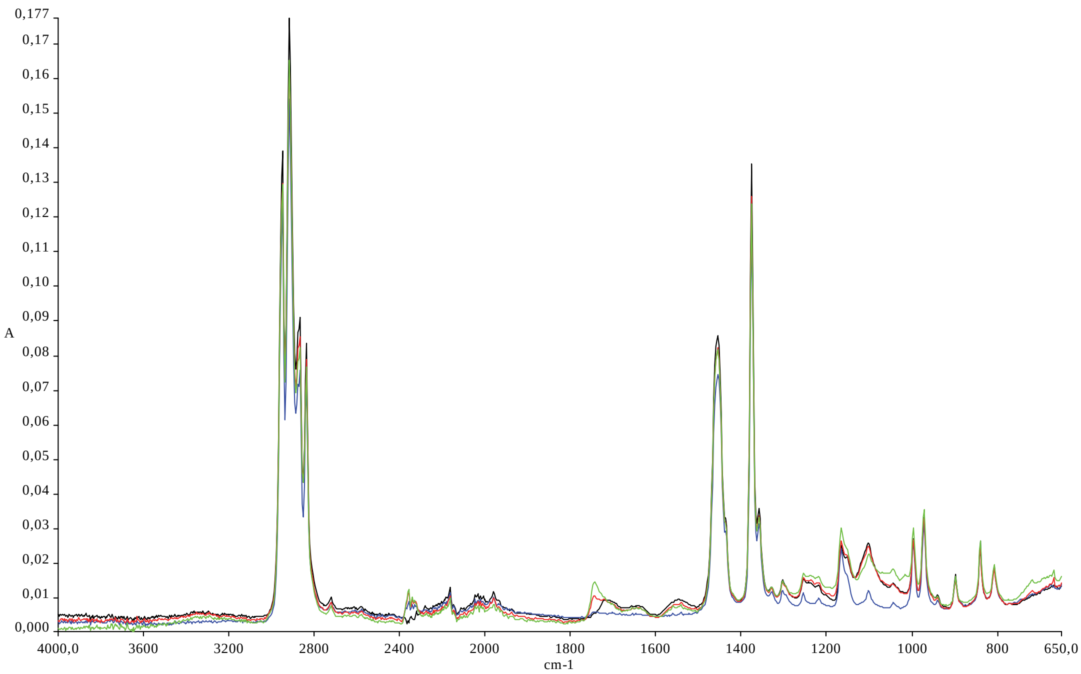
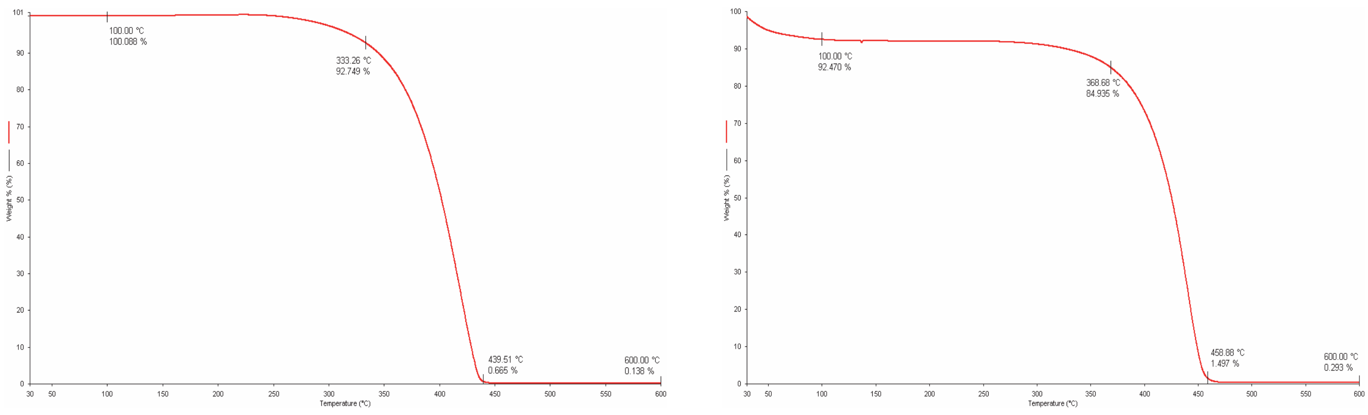


Figure 4. a) Blue: Untreated, b) Others: Limonene encapsulated liposome (with different binders)



a b

Figure 5. TGA Analysis a) Untreated Nonwoven Mask b) Nonwoven Mask with Liposome

The other thermal behaviour of liposome and its raw materials are presented in Figure 6. Moderate peak corresponding to the melting point of the active substance can be seen. Melting is accelerated at 150ºC for untreated nonwoven mask. When the DSC curve of limonene encapsulated liposome is examined, it is found out melting is started 155ºC.

3.5. Gas Chromatography Analysis

In order to examine the presence of limonene examine GC analysis were tested. On the nonwoven masks which are as the amount of limonene encapsulated liposome was determined 0,049 mg/kg. It has been concluded that survive limonenes capsules were obtained despite the passage of time over.

4. CONCLUSION

Liposome technology is new, clean and efficient and can be used in industry. Liposome technology can be used for volatile oils encapsulation. Limonene encapsulated liposomes are developed successfully. Surface morphology and formal structure of these three capsule formulations are studied by SEM images. TGA and DSC curves are examined and improved thermal behavior was observed because of the liposome structure. It is seen that capsules have an average diameter of 250 nm. Due to having such a small size, it is easier to get in fibre gaps.

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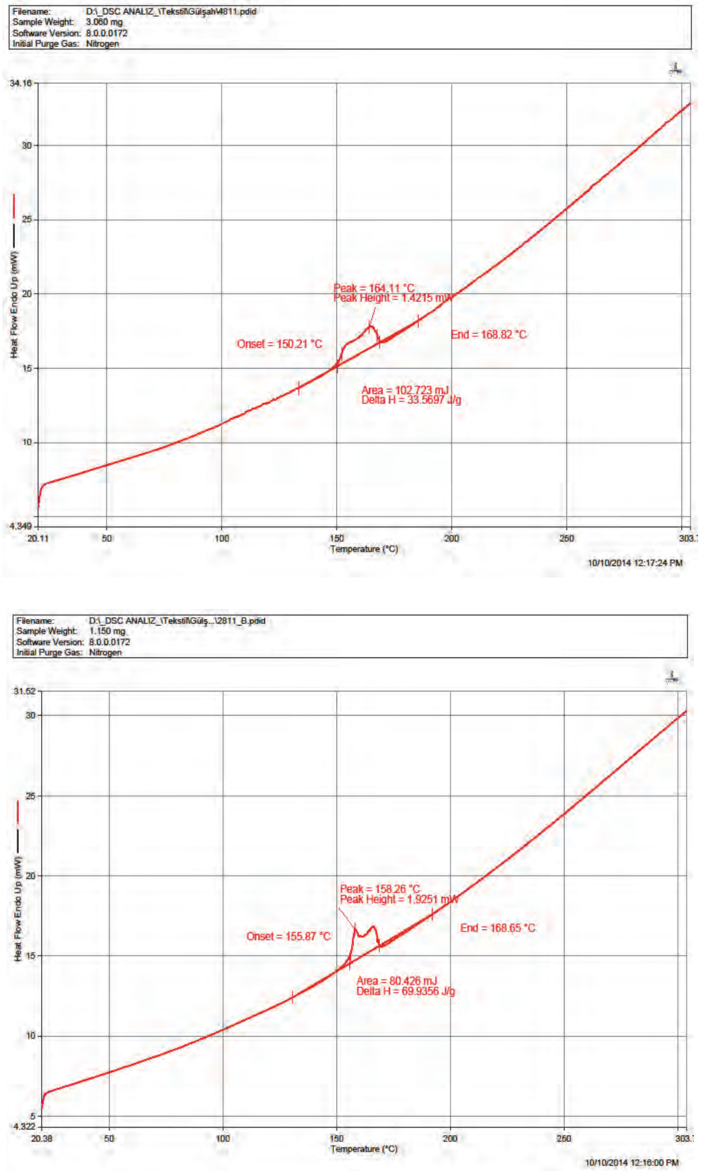

Figure 6. DSC Analysis a)Untreated Nonwoven Mask b) Nonwoven Mask with Liposome

Liposomes led to occur of new bonds according to FTIR diagrams. The resistance of the capsules are low but disposable products like this mask bad odors in the surrounding area would be suitable to be suppressed.

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