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ORIGINAL ARTICLES

Encapsulated Fragrance in Overprint Coatings

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ABSTRACT

This work is to incorporate scented inks in a small printed label of the perfume package. It focused on the technology of encapsulating the fragrance material in a polymer matrix using the sol gel process. The prepared solgel along with the encapsulated fragrance is added to the overprint coating which can then be coated on to the substrates used for labels. The results are discussed by analyzing the prepared solgel samples and by choosing the appropriate coating, fragrance material, solgel concentration and the substrates.

Key words: Perfume, sol gel, over print coating, Scented Inks.

Introduction

In the market, selection of perfumes of different flavors by the consumer is normally done by spraying the product (Helmut Kipphan,). This leads to loss of quantity and quality of the product. The above mentioned work is implemented means, the caps can be sealed completely and this eliminates the problem of opening the cap and spraying the product (Leach, Robert Pierce,; Simon Benita,; Tohru Yamamoto, c\o Nakata Laboratory; Mohanraj, VJ. and Y Chen, 2006; Lewis, J.S., M.S. Weaver, 2004). This would provide the customers, a confidence about the product security and thus enhancing the sales. To produce the desired smell of the perfume there is a need to know about the aromatic composition. It contains fragrance materials that are encapsulated. The printing ink consists of resin components (oils, natural and synthetic resins) which are dissolved into a solvent, pigments and dispersants (Banerjee, A.N., *et al*., 2006; Grüninger, A., A. Bieder, A. Sonnenfeld, 2006; Kemell, M., *et al*., 2008; Sammon, C., J. Yarwood, N. Everall, 2000; Southward, R.E., *et al*., 2002; Kukla, R., 1995). To produce the perfumed ink the perfumes must be added to the printing inks. Simply mixing the perfumes with the ink will produce a short time aromaticity because perfume also volatizes along with the solvents. Hence it affects the long term aromaticity (Minami, T., *et al*., 1995; Wu WF., BS. Chiou, 1997; Affinito, J., D. Hilliard, 2004). The process of enclosing a substrate inside a capsule is called microencapsulation. Encapsulation of perfumes prevents the perfumes from volatizing. The substance inside a microcapsule is usually a solid (or) a liquid, in this case the perfume to be encapsulated. It is used to make scratch N sniff stickers, which are used in advertisements. When the consumer scratches the sticker (or) the strip, some of the microencapsules break, releasing the scent.

Scratch N sniff is the trade name for a special kind of perfume (or) scent in which the scent is enclosed in minute capsules and printed, which can be broken open by friction (Hanika, M., *et al*., 2003; Wilson, C.A., *et al*., 2005; Ferguson, J.D., *et al*., 2004). Individual beads of scented oil, too small to be seen with the naked eye are encapsulated in plastic (or) gelatin and using specialized printing techniques the beads are printed on paper (Wilson, C.A., *et al*., 2008; Elliott, S.D., *et al*., 2006). The scent does not leak out until the beads are deliberately broken, because scratch N sniff patches keep a scent localized, it can be smelled only when someone deliberately scratches and sniffs.

The basic ingredients of Scratch N sniff (or) perfumed strips are water, oil, scent and either gelatin (or) a water soluble polymer usually polyoxymethylene urea. A certain chemical analyst is used to bring out the reaction. A water soluble adhesive is needed to affix the material to the paper during printing.

Overprint varnishes are the coatings to enhance and protect the printed substrate. They are applied with special coating units that are predominantly coupled in line to the printing press, after single (or) multicolour prints, the varnish application takes place inside the printing press.

1. Experimental:

1.1 Materials:

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The materials selected for this process are Sodium Metasilicate, ortho phosphoric acid, Vanillin of aroma compound. These were supplied by Angelin chemicals, Chennai.

The commonly used label substrates were maplitho of 80 gsm, art paper of 100 gsm and cream wove paper of 60 gsm were selected.

2.2 Preparation of sol gel:

The method used for the preparation of gel is the solgel process. The types of gel were formed with the different types of materials.

2.2.1 Gel formation with sodium metasilicate:

The sodium meta silicate of 1gm is dissolved in 40 ml of water (2.5% conc). The ortho phosphoric acid is added drop by drop by a micro pipette till a pH of 6.3 is obtained. It is measured using standard pH meter. The sol gel was formed in time duration of 6-7 hours.

2.2.2 Gel formation with sodium metasilicate and vanillin (Method 1):

The sodium meta silicate of 1gm is dissolved in 40 ml of water (2.5% conc). Vanillin of 1gm is dissolved in the same solution. The ortho phosphoric acid is added drop by drop by using a micro pipette till a pH of 6.3 is obtained. It is measured using standard pH meter. The sol gel was formed in time duration of 24 hours. The precipitation of vanillin occurred finally.

2.2.2 Gel formation with sodium metasilicate and vanillin (Method 2):

The sodium meta silicate of 1gm is dissolved in 40 ml of water (2.5% conc). The vanillin of 1gm is dissolved in ethanol till the entire vanillin dissolves completely in a separate beaker. The ortho phosphoric acid is added drop by drop by using a micro pipette till a pH of 6.3 is obtained and stirred well. At the stage of gel formation, the dissolved vanillin was added to the mixture and kept as such for few hours. Finally, a clear, transparent sol gel was obtained without any precipitation of vanillin. More aqueous content which can't be mixed with a hydrophobic printing ink / varnish.

2.3 Solution:

The obtained gel is converted into a xerogel. It is kept in an incubator at a temperature of 50ºc. This ensures solidification through diffusion and not through evaporation.

2.4 Concentration variations of sol gel mixing:

Sol gel samples of two different concentrations namely 5% and 15% were prepared using the method given below and the pore structures were analyzed using the SEM images.

2.4.1 Preparation of 5% sol gel (containing 5% of sodium Metasilicate):

Sodium Metasilicate of 2gms was dissolved in 40ml of distilled water. The pH of the solution was around 12.3. Two grams of vanillin was dissolved in 10ml of ethanol in a separate beaker. Ortho phosphoric acid was slowly added in drops using a micro pipette and stirred well till the pH dropped to 6.4. The solution was left behind for partial gelling for 20-25 minutes. The vanillin dissolved in ethanol was then added to the solution slowly and stirred. The solution was then made to a gel and kept in the room temperature for 2-3 hours. It was then made into a powder by placing it in the incubator at 50ºc for 15 hours. Finally white coloured powder was obtained.

2.4.2 Preparation of 15% sol gel (containing 15% of sodium Metasilicate):

1.5gms of sodium metasilicate was dissolved in 10ml of distilled water. The pH was around 12.6. 1.5gms of vanillin was dissolved in 8ml of ethanol in a separate beaker. Orthophosphoric acid was slowly added in drops using a micropipette and stirred well till the pH dropped to 9.8. The gel particles began to appear and by the time, the dissolved vanillin was added slowly by stirring. The gelation was occurred instantly. The gel was kept in the room temperature for 2 days to obtain the powder. The brown coloured powder was obtained finally.

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2.5 Coating:

The coating process was done using RK Flexo coater with the coating thickness of 12 microns. The coatings were done by the method of screen based varnish, water based coating, offset over print varnish, UV varnish.

Results and Discussions

3.1 SEM analysis of Sol gel powder:

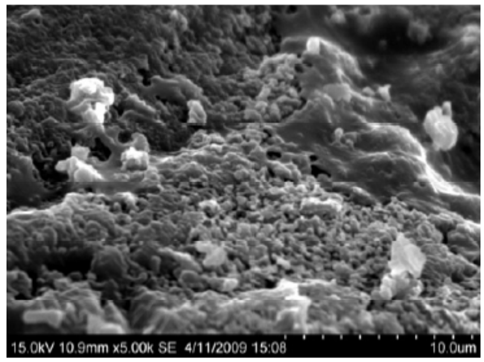

Fig 1: 15% conc. Sample (5000X).

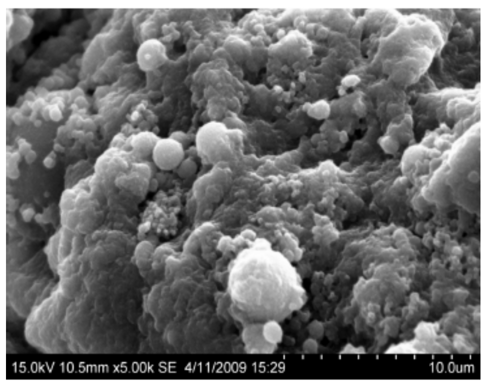

Fig. 2: 15% conc. Sample (5000X).

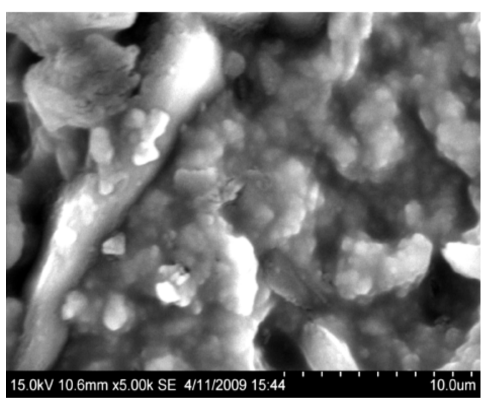

Fig. 3: 5% conc. Sample (5000X).

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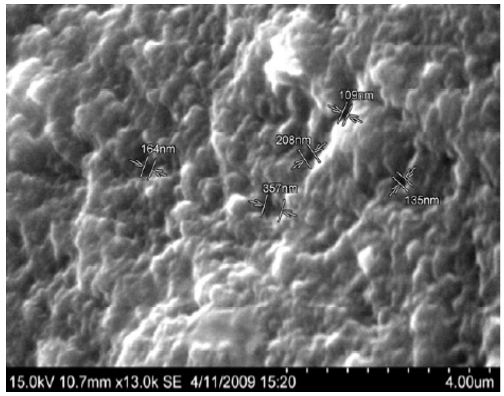

Fig. 4: 15% conc. Sample (13000X).

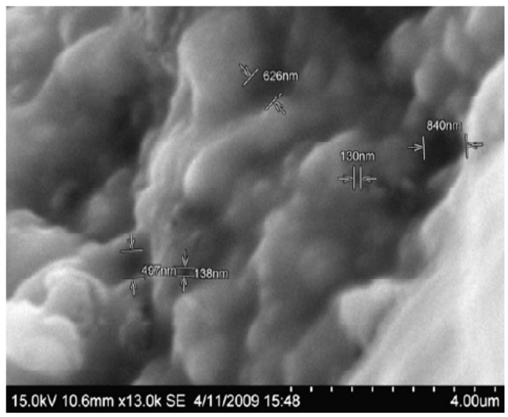

Fig. 5: 5% conc. Sample (13000X).

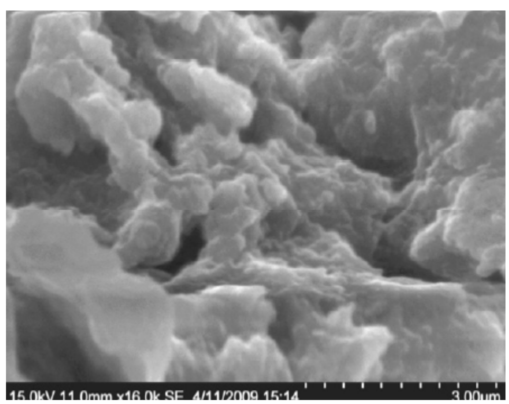

Fig. 6: 15% conc. Sample (16000X).

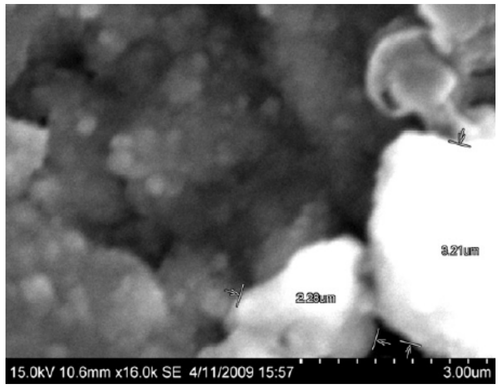

Fig. 7: 5% conc. Sample (16000X).

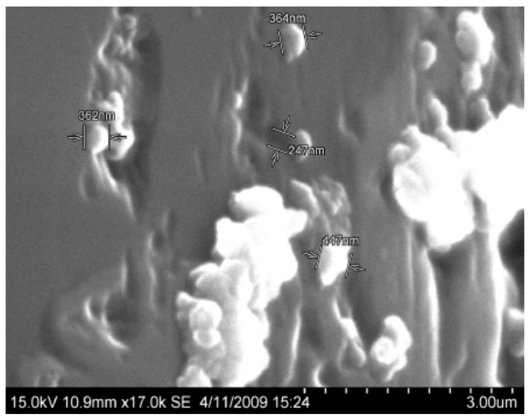

Fig. 8: 15% conc. Sample (17000X).

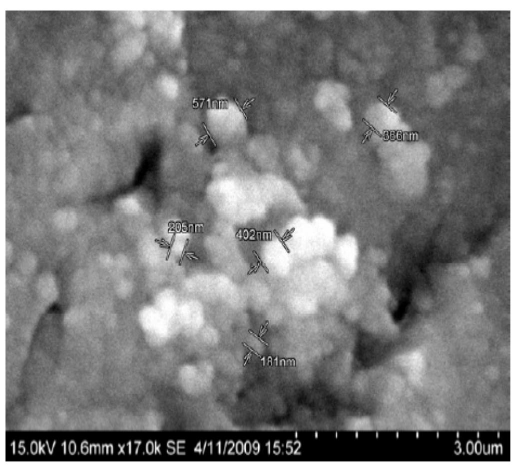

Fig. 9: 5% conc. Sample (17000X).

Fig 1 and 2 represents the SEM analysis (5000X) of 15% concentration of sample. In this the white coloured vanillin particles are visible in the pores. There is a well defined porous structure of sodium metasilicate. Fig 3 represents the 5% concentration of the sample. In this the pores are very less as compared to the samples 1 and 2. The water content is more and it has a very bulgy appearance. From the fig 4 (13000X) the size of the pore ranges from 357nm – 109nm. Different size of pores available in the different area of the substrates. In Fig 5 the size of the pore ranges from 840nm – 310nm. The magnification of 16000X of the samples is available in fig 6 and 7. Form this the porous voids are available in closer voids. The vanillin particles are very larger. From the fig 8 and 9 (17000 X) the clusters of vanillin in the cavities are available in

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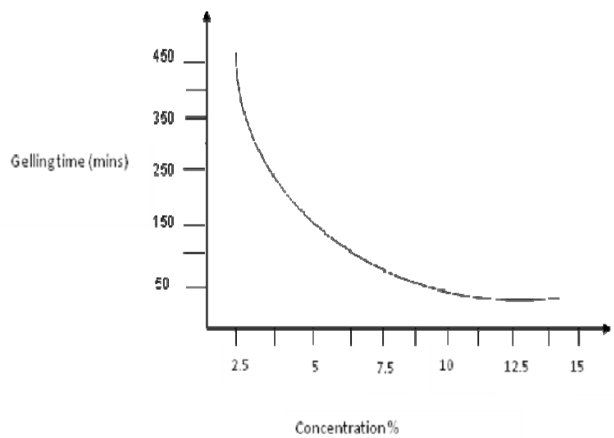
sodium metasilicate walls. The vanillin particles were agglomerated. From all in the 15% of solgel, more definite structures of pores were present. The void space ranges of 248nm. Because of the smaller range there is a better retention and longevity of smell are present. The brown colour appeared and it is basic. In 5% of sol gel concentration, the walls are not sharp enough. The water contents also more in it. The void space ranges of 710nm. It appeared in white colour and it is said to be acidic.

3.2 Variations in solgel concentrations:

Sodium metasilicate and vanillin dissolved in ethanol is added in equal proportions in distilled water.
The different concentrations are:
2.5% = 40ml (Distilled water): 1g/1g (Sodium metasilicate / Vanillin)
5% = 40ml (Distilled water): 2g/2g (Sodium metasilicate / Vanillin)
7.5% = 20ml (Distilled water): 1.5g/1.5g (Sodium metasilicate / Vanillin)
15% = 20ml (Distilled water): 3g/3g (Sodium metasilicate / Vanillin)
The observations are:
Gelling time Vs concentration



From the graph, as the concentration increases, the gelling time decreases. Initially the gelling time is high when the concentration is less.

3.3 Over print coatings:

3.3.1 Screen based varnish:

In the screen based varnish, the gel is made into powder and it is added with screen varnish with 5% concentration. But the viscosity was found to be too high. In order to reduce the viscosity, turpentine was added. When sol gel powder was added after reducing the viscosity of varnish using turpentine, the sol gel powder was insoluble. The particles were retained when it was coated in the paper.

The sol gel powder was then mixed with the varnish and then turpentine was added. The sol gel powder was dissolved completely, but there were drying problems. The resulting coating was coated on Maplitho paper of 80gsm and art paper of 100 gsm. In maplitho, problem of see through occurred and in art paper, though there were no see through problem, but drying problem was pronounced.

The screen varnish was finally discarded because of drying problems and dominating solvent smell.

3.3.2 Water based coating:

In this, a different concentration of 10%, 20% and 22% of sol gel powder was mixed with coating. As the concentration of mixing increases, the amount of smell also increases. The gel concentration is only 5%. The maximum limit of concentration of mixing is upto 22%. Beyond this percentage, the mixture gets solidified. It is finally noted that 21-22% is stable for mixing.

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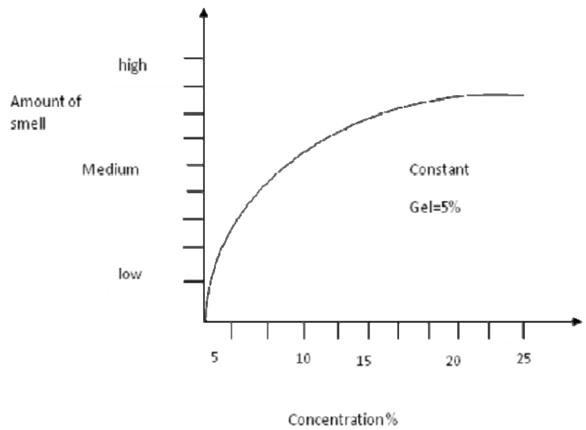
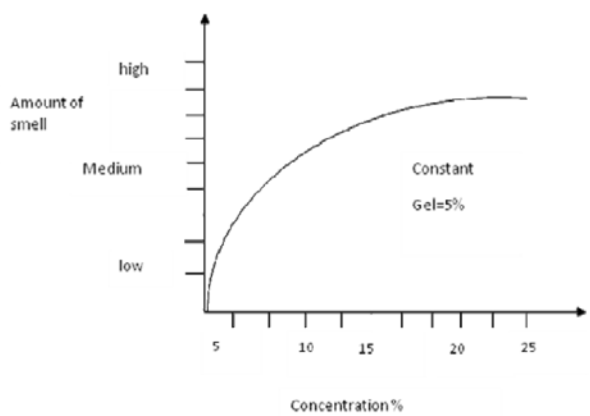
Gel concentration Vs Smell:



From the graph, when the concentration of gel increases, the smell also increases.
It is achieved till 50%. Beyond 50%, dissolving was not proper during the initial preparation.

3.3.3 Offset overprint varnish:



In this varnish, as the concentration of mixing increases, the amount of smell also increases. The gel concentration is upto 5%. At the time of mixing, the maximum limit of concentration was 30%. Beyond this 30% concentration, it was very difficult to coat because of solidification in nature. In this 25% was suitable for mixing.

3.3.4 UV varnish:

The sol gel powder was mixed with UV varnish at 25% concentration. The coating was dried at 360nm of UV radiation for 30 min. The coating was cured but the desired smell was not obtained. This was due to the radiation decay of particles.

2. Conclusion:

The screen varnish was finally discarded because of drying problems and dominating solvent smell. 20% of sol gel concentration in water based coating was found to be optimum, beyond which the coating was solidified. 25% of sol gel concentration in offset over print varnish was found to be optimum. The UV varnish was totally discarded as the desired smell was not obtained. As the maplitho paper of 80 gsm, art paper of 100 gsm, creamwove paper of 60 gsm are the commonly used label substrates, the discussed water based coating were coated on these substrates. It was observed that, the maplitho paper was found to be much suitable for fragrance retention.

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