International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056
Volume: 03 Issue: 04 | Apr -2016 www.irjet.net p-ISSN: 2395-0072

AN OVERVIEW OF PROPERTIES OF CORK – A BOTTLING APPROACH

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Abstract - ***Cork is a material which has been used for multiple applications. The most known uses of cork are in stoppers (natural and agglomerated cork) for alcoholic beverages, classic floor covering with composite cork tiles (made by the binding of cork particles with different binders), Cork is a natural, renewable, sustainable raw material that has been used for many centuries. As a result of this very long term interest, the scientific literature on cork is extensive. Cork is resilient, strong (high specific strength), impervious to water, has a near zero Poisson coefficient, very low thermal conductivity, low density and a complex chemical structure. This combination of properties provides cork with characteristics hard to match with other materials: excellent sealing ability and ease of removal, thermal comfort and damping for walking, thermal insulation at very low temperatures, among others. In this paper, study of different types of cork and their application is carried out.***

Key Words: *Material properties, cork, chemical composition.*

1. INTRODUCION

Cork is the bark of the cork oak tree. Cork is a cellular natural material, very versatile, very light in weight, elastic, flexible, impermeable to gases or liquids, and good electric insulator, as well as a thermal, sound and vibration insulator and also a dielectric material. Its unique properties arise from its closed cell structure.

(a)

(b)

Fig 1. Principle Cork design

Cork physical-mechanical characteristics make it an excellent material for thermal insulation, most advantageously, e.g., in cold chambers where compressive loads are present, and also for acoustic absorption (e.g., recording studios) and vibration insulation (e.g., machinery). Its pleasant sensation to the touch, energy absorbing and anti-sliding properties make it also good for coverings, shoes or in handles. Its compression-recovery properties make it the material of choice for seals and joints in civil construction, woodwind instruments and combustion engines and, of course, as stoppers [1,2].

2. TYPES OF CLOSURES

There are different types of closures used in bottling industry.

1. Natural Cork:

Natural cork is quintessential to the heritage of the wine industry, it supports a nation, and is indeed its best ambassador. The forests are a unique ecological feature in Portugal's landscape and there is enough scientific evidence to validate this. Romantic and sentimental reasons aside, the very real susceptibility to contamination by TCA will remain the proverbial sword of Damocles hanging over the entire cork producing industry. A cork oak tree may start its life by one of two methods – either under controlled nursery conditions or natural germination of an acorn. The tree has a very slow and gradual growth pattern. It needs a lot of sunlight, relatively little rain, a degree of humidity and can grow up to 1400m above sea level. The tree itself and the care of the soil are the two basic divisions of cork oak husbandry. The soil is tilled periodically with the undergrowth being cleared out every four to five years. These practices enhance the cork's economic value (in terms of quality and quantity) as well as increasing the tree's vigour. The forest's density is regulated by selective thinning and removal of aged trees. Not unlike viticultural practices, pruning is also undertaken to train young trees, maintain the form and vigour of mature trees and revitalise older trees.

2. Synthetic Cork:

Essentially plastic synthetic closures are manufactured using man made materials the composition of which is akin to state secrets – but are created without the fine pores which the natural cork has. The elimination of these pores which can harbour bacteria is what makes these closures so attractive. The material from which all synthetic closures are manufactured is either medical or

food grade plastic. They are guaranteed not to be the source of any microbiological taint. Their design also satisfies the traditional wine drinker's need to extract a closure using a corkscrew.

But these closures too have been shrouded with a degree of uncertainty and a somewhat sceptical past. The producers of synthetic closures also had to overcome product limitations and re-engineer and attend to specific aspects of production. They too have had their fair share of litigation and unhappy clients. But as this closure is made through a controlled process and is monitored every step of the way, the assurances and guarantees which suppliers such as SupremeCorq and nomacorc are able to give, unquestionably outweigh those of the natural cork producers. The sales brochures from both these suppliers make emotive statements as to the dreams and reputations of wineries and indeed their family heritages being at stake when wine bottles are sealed - all these concerns are reassured as being laid to rest should the wine producer select synthetic closures.

3. Screw Cap:

The closure issue is highlighted most profoundly by the debate which pits defenders of tradition against practically minded dispassionate people who view the selection of closure in the clearest light – and the choice of screw caps provides an arena in which to do it. Screw cap refers to any metal cap which is capped over a bottle top; the term Stelvin is used nowadays interchangeably but should specifically refer to the patented closure of Pechiney, France and the term Savin cap to refer to the product of MCG Industries in South Africa.

3. MESSAGE IN A BOTTLE: PROCESS INNOVATIONS IN THE CORK STOPPER FIGHTBACK

Soumodip Sarkar [3] analyzes how the cork stopper industry is attempting to resolve the problems of technical efficiency arising from the contamination by TCA and other volatiles. We use the case of Amorim and Irmãos S.A., the single largest cork stopper manufacturer in the world with over one-fourth of the global market share, analyzing it's process innovations in the battle against contamination. The success of these process innovations could well prove crucial for the entire cork industry not only to stem the rise of alternative stoppers but also in recapturing some of the lost market share.

There are a variety of types of cork stoppers, depending upon the quality and purpose of the wine. Whole *natural cork* is punched out from a single strip of superior quality. The higher quality grades of corks would originate from a finely structured whole piece of cork bark with minimal imperfections. The longer the cork and fewer the flaws, the higher is the quality and the greater the price. Natural cork closures are graded according to seven or eight categories, depending on both quality and visual criteria.

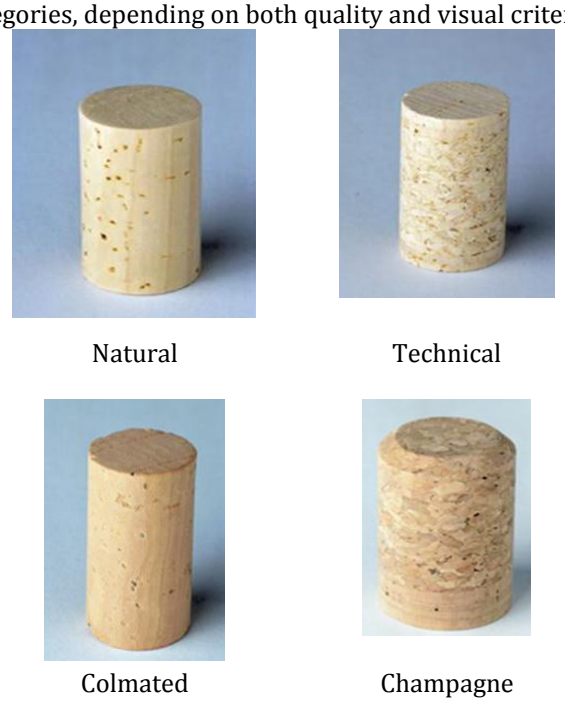

Fig 2 Types of Cork Stopper

4. NEW CORK-BASED MATERIALS AND APPLICATIONS

Luis Gil [4] has performed the study of last five years of innovative cork materials and applications also mentioning previous work not reported before.

a. Densified Insulation Corkboard

This material (see Figure 1) is based on the densification of current insulation corkboard (ICB) also called expanded corkboard, which is a completely natural product, with no added binding agents. It is possible to produce this denser material with a wide range of operational conditions and therefore of products, with densities ranging from the maximum value possible for current ICB, usually from 250–300 kg/m3 to 750 kg/m3 or more. The densification of ICB is performed by heating the boards and hot pressing under pressure, temperature and time conditions such that irreversible densification is achieved. This has a smoother surface and better characteristics for new applications. Its manufacturing process is easy to adapt to current production and allows a diversification in production and in applications. Economic studies have shown that it can be competitive with some products on the market (e.g., wood-based materials, other cork-based materials). Some of the possible uses include floor coverings, wall and ceiling coverings, false (suspended) ceilings, screen and door panels, skirting boards, sandwich panels and furniture

Several R&D results on cork derivatives are now waiting for the next step of industrialization. Cork derivatives are one of the most promising fields for cork technology development.

Fig 3 Samples of different densified insulation corkboard (ICB) materials [4]

Some possible applications are foreseen by the authors of the several referenced works. However, engineers, architects, designers and other professionals can and should also think in new possibilities, potentially leading to the production and use of these products.

5.CORK: PROPERTIES, CAPABILITIES AND APPLICATIONS

S. P. Silva et.al [5] have analyzed chemical structure in detail, covering both the materials that form the wall structure and the low molecular weight, extractable components. The unique properties of cork are discussed and correlated with current knowledge on morphology and chemical structure. Finally, the important industrial applications of cork are reviewed, in the context of research to provide cork with novel, high added-value applications

Mechanical properties

The nomenclature used for directions and sections in cork is that generally used in the description of wood.97 Following the nomenclature used in literature and in the section 'Microscopic morphology' above, they will be referred to below as radial (R) or non-radial (NR), the latter corresponding to the tangential or axial direction.

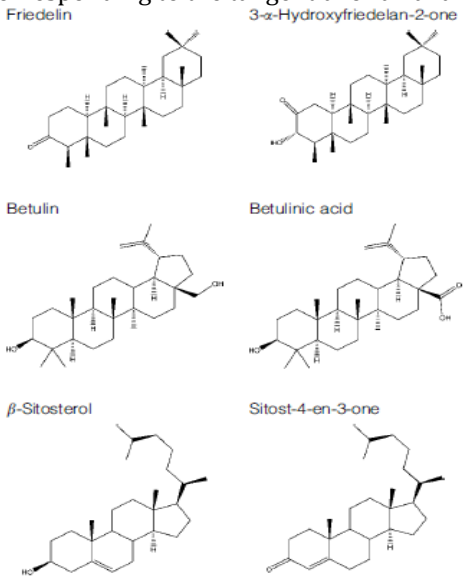

Fig 4 Triterpene structure present in cork[5]

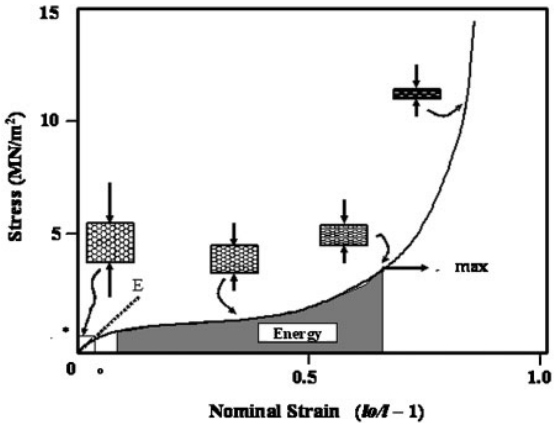

Fig 5 Typical compressive stress–strain curve for cork [5]

Cork has a remarkable combination of mechanical, chemical and morphological characteristics. This natural organic material continues to be widely used. It has evolved from simple, direct usage of the raw material, through products involving some industrial transformation to the point where it now represents a potential source material for high technology industries (pharmaceutical, ceramic, etc.). This evolution has been supported and facilitated by the use of increasingly complex characterization techniques that set the foundations for a realisation of the full potential of cork. From the initial microscopic observations of Hooke, cork has been the subject of diverse mechanical, physical, chemical and morphological characterization, lately including thermally stimulated discharge current analysis, nuclear magnetic resonance and gas chromatography–mass spectroscopy.

6. CONCLUSION

Cork has proved to be a highly adaptable material, giving rise to products of low and high incorporated technology. The continuing interest, the increasingly detailed characterization and society's growing requirements for natural, renewable and sustainable raw materials will create novel market areas. In the research field, chemical characterization and some physical properties still pose challenges and a significant contribution can be anticipated in areas of concern to the development of novel applications for cork and cork incorporating products.

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