MedCrave
Step into the World of Research

Journal of Analytical & Pharmaceutical Research

Short Communication

Open Access

CrossMark

New Si-PSA tape with cellulose fibers–obtaining and usefully properties

Abstract

The article describes the preparation of new compositions based on silicone pressure-sensitive adhesives and cellulose fibers. Self-adhesive tapes obtained on their basis with content from 1 to 7% wt. calculated on the dry weight of the polymer in resin. It is well known that self-adhesives on the silicone pressure-sensitive adhesives base are high quality products used for special applications. The use of cellulose fibers was aimed at strengthening the Si-PSA cohesion. The effect of the filler additive on the basic properties of tapes and composition has been noted.

Keywords: silicone pressure-sensitive adhesives, cellulose fibers, biocomposites

Volume 7 Issue 3 - 2018

Adrian Krzysztof Antosik, Zbigniew Czech

Institute of Organic Chemical Technology, West Pomeranian University of Technology Szczecin, Poland

Correspondence: Adrian Krzysztof Antosik, Institute of Organic Chemical Technology, West Pomeranian University of Technology Szczecin, ul. Pulaskiego 10, 70-322 Szczecin, Poland, Email adriankrzysztofantosik@gmail.com

Received: March 01, 2018 | **Published:** June 22, 2018

Introduction

The first information about self-adhesive adhesives has been recorded 6000 years BC in Egyptian civilization. Pressure-sensitive adhesives (PSA) is a specific group of self-adhesive materials – first time use in the late 19th century, where they were used as medical tapes and dressings), which keep self-adhesive properties at room temperature. There are many types of PSA that differ in the properties or materials from which they are obtained. Acrylate-based pressure-sensitive adhesives or other carbon-based polymers are known as one of the most popular.[1–3]

It is well known that from PSA silicone pressure-sensitive adhesives (Si-PSA) are the most commonly used adhesive for special applications. A combination of the unique properties of silicones, such as high Si–O–Si backbone flexibility, low intermolecular interactions, low surface tension, excellent thermal stability and high UV transparency, often explains why silicone PSAs have superior performance at high- and low-temperature extremes, excellent electrical properties, chemical resistance and outstanding weathering resistance compared toorganic PSAs. They are inert and very hydrophobic but still have reasonable moisture permeability.[4–7]

Cellulose fibers are one of the varieties of the cellulose form that differ in their physical properties. Cellulose fibers (about 100µm long) cleaned and separated from other substances (eg lignins) are characterized by good chemical resistance and good mechanical properties as well as relatively low price.[8] Chemical and physical modifications carried out on cellulose fibers aim to increase their adhesion to polymer matrices. Such modifications allow the improvement of mechanical properties of the composite.[9] Unmodified cellulose fibers are used in the textile, building and paper industry.[10–12] They were used in the production of membranes for the treatment of water on ships and industrial treatment thereof, and as a biodegradable reinforcement in composites. The addition of cellulose fibers to cement materials results in a decrease in plastic shrinkage, tendency to cracking and increase in mechanical strength of concrete.[8,9,13]

In this paper commercial silicone pressure-sensitive adhesives and cellulose fibers will be used to obtained pressure-sensitive adhesives composition using to prepared self-adhesives tape. In the available literature there are no reports about used cellulose fibers as filler in obtained self-adhesives tape based on silicone pressure-sensitive adhesives.

Materials and methods

Based composition was obtained by use commercial silicone pressure-sensitive adhesive (acronym: PSA 529), which was product of Dow Corning (USA) and crosslinking agent (dichlorobenzoyl peroxide - DClBPO) which was product of Peroxid-Chemie (Germany) was mixed to obtain homogeneous composition containing 50 wt. % polymer (2.5 wt. % on a base of polymer content DClBPO). After that composition was physical modificated added cellulose fibers (acronym: Arbocel Type UFC 100), product of J. Rettenmaier & Sohnf (Germany) respectly from the resulting composition 1, 3, 5 or 7% wt. (calculated on the dry weight of the polymer in resin) and mixed to obtained homogeneous composition. Then, composition was coated with coat speed of 5cm/s on polyester film (36µm), and dried for 10 min at 110°C in drying canal. Thus obtained adhesive film was protected with polyester film (50µm). Obtained tapes were used for further tests, i.e. adhesion, tack and cohesion measured. To compared results tape based on composition without filler was analogously obtained. On obtained Si-PSA viscosity and organoleptic measurement was conducted.

Usefully properties of Si-PSA self-adhesives tape as peel adhesion, tack, cohesion was measured according to international standard Association des Fabricants Europeens de Rubans Auto-Adhesifs and Fédération Internationale des Fabricants et Transformate ursd'adhesifs et thermo-collants sur-papiers etautres support respectively AFERA 4015, AFERA 4001 and FINAT-FTM 8 by using Zwick-Roell Z1 machine (Germany) and machine designed at the Laboratory forAdhesives and Self-Adhesive Materials of the West Pomeranian University of Technology Szczecin.[6,14–16] The effect of the filler on viscosity of composition after 90 days in order to determine its stability (on the Brookfield viscometer) was determined and organoleptically determined whether the filler falls over time, it's one of the most important properties of ready-made compositions for companies, defining the storage capabilities of semi-finished products (before coating).[6]

Submit Manuscript | http://medcraveonline.com

©2018 Antosik et al. This is an open access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and build upon your work non-commercially.

Results and discussion

Influence of content cellulose fibers on viscosity and stability after 90 days of Si-PSA were collected in Table 1. In all cases of filling the stability of the composition, organoleptically tested seemed correct after 90 days. For high-fill samples, filler deposition was noted. All sample tests showed a higher viscosity from the sample without filler. The viscosity increased with the addition of the filler. This means that if you want to store a composition with a higher degree of filling, filler sedimentation should be expected-which means that the coating should be mixed up again before coating. The described viscosity increase compared to less fill samples will additionally impede mixing and may reduce the performance of the coated compositions after storage. In order to avoid these problems, compositions with a higher degree should not be stored for a long time but should be coated on a regular basis.

Table 1 Influence of cellulose fibers on composition PSA 529 after 90 days

Content of dolomite [% wt.]	Viscosity [Pas]	Stability
0	2250	N/A
1	5950	no changes
3	6350	no changes
5	9250	filler it settles on the bottom
7	10400	filler it settles on the bottom

To have opportunity of compared reference to physically modified compositions basic information about composition PSA 529 crosslinking by 2.5% wt. DClBPO was collected in Table 2.[15] With the addition of cellulose fibers all tape usefully properties (e.g. adhesion, tack, and cohesion–in composition with high filling) was decrease. Decreasing this value it improves the negative effect of the filler on the obtained self-adhesives tape. When compared to ordinary silicone-based pressure-sensitive adhesives,[6,15] the pressure-sensitive adhesives obtained (due to the bio-filler that can be weighted for a bio-composite) do not meet the basic requirements of PSA.[15,16]

Table 2 Influence of cellulose fibers on usefully properties of tapes PSA 529

Content of dolomite [% wt.]	Adhesion to steel [N/25mm]	Tack [N]	Cohesion [h]
0	15.7	8.3	> 72
1	5.1	5.6	> 72
3	4.6	4.3	> 72
5	4.5	4.0	> 72
7	4.1	3.9	39

Conclusion

Novel silicone pressure-sensitive adhesives composition and based on them self-adhesives tapes with cellulose fibers used as a bio-filler have been obtained. The introduction of bio-filler in the adhesive composition was to help create technology meets the principle of „5E", which are efficiency, energy saving, enabling, economy and environmental friendly,[17,18] unfortunately in generally additive filler decreased basic properties of Si-PSA as adhesion, tack and cohesion and increasing composition viscosity. It is generally accepted that one-sided adhesive tape must meet the basic properties (adhesion >10N/25mm; tack >8 N/25mm; cohesion >72 hours)[15] for novel tape olny cohesion is on acceptable level, what sugest that tape can by used in industry but not for every application. Unfortunetly cost of production self-adhesives materials with that value of adhesion nad tack can be unprofitable, especially due to cheap replacements already on the market.

Acknowledgements

None.

Conflict of interest

The author declares that there is no conflict of interest.

References

1. Czech Z, Kowalczyk A, Świderska J. Pressure-sensitive adhesives for medical applications. *Wide Spectra of Quality Control*. 2011;17:309–332.
2. Antosik KA, Czech Z. Si-Psa Tape with the Addition of Dolomite. *Archives of Organic and Inorganic Chemcal Sciences*. 2018;1(5):1–3.
3. Czech Z, Kowalczyk A, Shao L, et al. Novel acrylic pressure-sensitive adhesive (PSA) containing silver particles. *Journal of Adhesion Science and Technology*. 2013;27(13):1446–1454.
4. Lin SB, Durfee LD, Ekeland RA, et al. Recent advances in silicone pressure-sensitive adhesives. *Journal of Adhesion Science and Technology*. 2007;21(7):605–623.
5. Anderson GL, Stanley SD, Young GL, et al. The effects of silicone contamination on bond performance of various bond systems. *The Journal of Adhesion*. 2010;86(12):1159–1177.
6. Antosik K, Ragańska P, Czech Z. Termiczne sieciowanie samoprzylepnych klejów silikonowych nadtelenkami organicznymi. Polimery. 2014;59(11-12):792–797.
7. Mecham S, Sentman A, Sambasivam M. Amphiphilic silicone copolymers for pressure siensitive adhesive applications. *Journal of Applied Polymer Science*. 2010;116(6):3265–3270.
8. Ma H, Burger C, Hsiao BS. et al. Ultra-fine cellulose nanofibers: new nano-scale materials for water purification. *Journal of Materials Chemistry*. 2011;21:7507–7510.
9. Baiardo M, Frisoni G, Scandola M, et al. Chemical modification of natural cellulose fibers. *Journal of Applied Polymer Science*. 2002;83(1):38–45.
10. Ghanbarzadeh B, Almasi H, Entezami AA. Improving the barrier and mechanical properties of corn starch-based edible films: Effect of citric acid and carboxymethyl cellulose. *Industrial Crops and Products*. 2011;33(1):229–235.
11. Ghanbarzadeh B, Almasi H. Physical properties of edible emulsified films based on carboxymethyl cellulose and oleic acid. *International Journal of Biological Macromolecules*. 2011;48(1):44–49
12. Tharanathan RN. Biodegradable films and composite coatings: past, present and future. *Trends in Food Science & Technology*. 2003;14(3):71–78
13. Mohamed MAS, Ghorbel E, Wardeh G. Valorization of micro-cellulose fibers in self-compacting concrete. *Construction and Building Materials*. 2010;24(12):2473–2480.
14. Antosik K, Czech Z. Acrylic-silicone pressure-sensitive adhesives. *Organic and Medicinal Chemistry*. 2017;4:1–3.
15. Antosik K, Bednarczyk P, Czech Z. Jednostronnie klejące taśmy na bazie samoprzylepnych klejów silikonowych–dobór najlepszej kompozycji. *Chemik*. 2015;69(12):95–97.
16. Antosik K, Bednarczyk P, Czech Z. Aging of silicone pressure-sensitive adhesives. *Polymer Bulletin*. 2018;75(3):1141–1147.
17. Liu HB, Chen MC, Huang ZT, et al. The influence of silicon containing acrylate as active diluent on the properties of UV-cured epoxydiacrylate films. *European Polymer Journal*. 2004;40(3):609–613.
18. Athawale VD, Kulkarni MA. Preparation and properties of urethane/acrylate composite by emulsion polymerization technique. *Progress in Organic Coatings*. 2009;65(3):392–400.