Fig.3 – Dynamic contact stress of system Fig.4 – PDF and CGF of system (MCS- Monte Carlo simulation)

3.3. Reliability-based sensitivity analysis

Reliability-based sensitivity is the <u>partial</u> <u>derivative</u> of distribution parameter for basic random variable. The mean-value sensitivity and standard deviation sensitivity are used to analyze the characteristics of variables in the transmission system in Eq.(5). The sensitivity analysis method is widely used to find the sensitive factor, research parameters' effects and optimize the structure. For example, the tooth thickness of sun gear is the most significant random structural parameter with respect to other gears' thicknesses in the transmission system. The sensitivity value implies the influence of mean and standard deviation of corresponding variables on the system reliability.

$$S_\mu = \frac{\partial R}{\partial \mu_j} \cdot \frac{\mu_j}{R} = \int_\Omega \frac{\partial f_L(l)}{\partial \mu_{X_i}} \cdot \frac{\mu_j}{R} \, \mathrm{d}l, \; S_\sigma = \frac{\partial R}{\partial \sigma_j} \cdot \frac{\sigma_j}{R} = \int_\Omega \frac{\partial f_L(l)}{\partial \sigma_{X_i}} \cdot \frac{\sigma_j}{R} \, \mathrm{d}l. \qquad (5)$$

Conclusion

Stress-strength interference model and Saddle-point approximation method are proposed to analyze the dynamic reliability of transmission system in shearer loader. A reliability-based sensitivity method is proposed to improve the system performance on the basis of dynamic response analyses.

References

[1] Yimin Zhang, Qiaoling Liu and Bangchun Wen, Practical reliability-based design of gear pairs, Mechanism and Machine Theory. 38 (2003): 1363-1370.

[2] Ronald W. Butler, Saddle-point approximations with applications, Cambridge University Press, 2007, pp. 2-51.

УДК 664+621.798
SOLUTIONS OF FOOD POLYSACCHARIDE BLENDS FOR EDIBLE FILMS PRODUCTION

Huo Po, Tatsiana Savitskaya, Dzmitry Hrynshpan,
Lizaveta Gotina, Kaleynik Anastasia, Hu Xuchang, ZengWeixin
Belarusian State University, Zhejiang Shuren University
E-mail: che.gotina@bsu.by

Abstract. The study of the rheological properties of aqueous solutions of starch blends with sodium alginate and agar-agar as well as the physico-mechanical properties of bicomponent films on their basis has been carried out. The extreme behavior of polymer blends with low content of one of the polymers is described in terms of mutual solubility or thermodynamic compatibility. There is a tendency of mechanical properties and water solubility increase with the increasing of SA and AA polymers in corn starch matrix. Obtained data evidence the benefits of bicomponent films production instead of starch-based films.

Among a number of means to help preserve the health of the environment one can find photo-, bio- and water degradable packaging made from certain polymer materials. Starch was the first natural polymers for the production of biodegradable packaging materials because of its good biodegradability and low cost.

Edible films and coatings are becoming the next new thing in the field of biodegradable packaging, attracting attention of scientists, manufactures and consumers. Starch once again remains at the forefront of edible film making. However, the application area of starch is limited as it is an example of hydrophilic, hygroscopic substance with retrogradation properties (change of structure during storing). Starch is blended with other natural polymers to modify its properties. For this purpose in the current work corn starch (CS) was used as a base polymer and sodium alginate (SA) and agar (AA) as additives.

The following bodies of interest are covered in the current work: influence of polymer ratio in solution on rheological properties (such as overall viscosity, flow energy and parameters of Ostwald de Waele, Hershely-Buckely, Bingham and Casson rheological models (table 1)) and physico-mechanical properties (tensile strength, elongation, water permeability).

Table 1. Rheological models equations used for solutions flow behavior description

Name	Equation	
Ostwald de Waele	$\tau = K\dot{\gamma}^n$	(1)
Hershely-Buckely	$\tau = \tau_0 + K\dot{\gamma}^n$	(2)
Bingham	$\tau = \tau_0 + K\dot{\gamma} + C\dot{\gamma}^2$	(3)
Casson	$\tau = (a\sqrt{\dot{\gamma}} + \sqrt{b})^2$	(4)

Solutions with CS to SA or AA ratios 99:1, 98:2, 95:5, 90:10, 80:20, 70:30, 60:40 and 50:50 were under study. All solutions were prepared by consecutive addition of polymers to the common solvent under constant mechanical stirring. Solutions were heated to 90-95°C for 30 minutes. Part of prepared solutions was used for rheological measurements and the other was taken for film formation done by casting the solution on a clean smooth glass surface. Before casting film the formation temperature was measured. Films were dried in a drying cabinet at 60°C, after which peeled off and kept in 52% relative humidity conditions.

Rheological measurements were carried out on the R/S Brookfield rheometer with a regime of constant share rate with the help of coaxial cylinders CC25 at 323 till 363 K.

The physico-mechanical properties were measured according to standard ASTM D882 on the Zwick/RoellZ 0.5 machine.

Following conclusions have been made:

1. The addition of the chosen polymers to CS leads to growth of overall viscosity. In the case of both polymers 3 areas of growth can be distinguished: an intense increase of viscosity when additive content is below 2%, a plato in which the viscosity grows very slightly between 2-5% of additive followed by the last area where viscosity exhibits monatomic growth almost as intense as in the first area (figure 1).
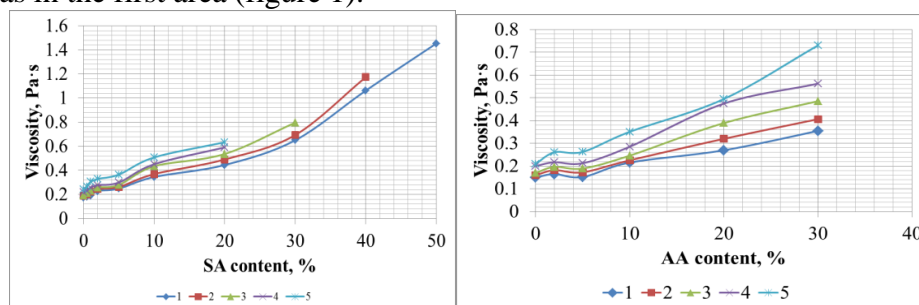

Figure 1 – Dependence of viscosity on SA (a) and AA (b) content at different temperatures (shear stress rate 1000 c⁻¹): a: 1-343 K, 2-333 K, 3- 323K, 4- 313K, 5- 303K; б: 1-353 K, 2- 343 K, 3- 333K, 4- 323К, 5- 313K

2. For both CS:SA and CS:AA solutions among the four used rheological models the best fit was observed for the power laws: equations (1) and (2) in Table 1 (up to R^2=0,999) and was worse for Bingham and Casson models. Hershely-Buckely critical shear stress model coefficient τ_0 in general decreases with addition of SA meaning that such an additive prevents the gel formation process of the CS network. Solutions with SA content of more than10% do not exhibit the properties of elastic bodies (the coefficient value is less than 0). Maximum value of τ_0 is present at 2% SA content implying the greatest organization of the polymer system in the solution. In CS:AA solution the opposite tendency is observed – the τ_0 coefficient increases with the addition of AA. So SA and AA act differently on the CS matrix: SA prevents gel formation whereas AA solutions commonly form hard gels.

3. Blending CS and SA in water, as a common solvent, resulted in bicomponent films, characterized by extreme dependency of physico-mechanical properties on the content with low SA concentrations. For example, 2% SA concentration enhances CS film tensile strength by 36% and grows elongation. Figure 1 demonstrates that the following SA content increase indicates gradual tenacity growth. This is true since SA film is almost 3 times stronger than CS film. Relative elongation of bicomponent films diminishes, but does not become lower than CS film parameters.

MNCOGE-FENISI 复合型磁制冷材料的结构与磁热效应的研究
STUDY ON STRUCTURE AND MAGNETOCALORIC EFFECT OF MNCOGE-FENISI COMPOSITES MAGNETIC REFRIGERATION MATERIAL

Wu Wenbin
Belarusian State University
E-mail: 358526697@qq.com

Abstract: *$Mn_{16}Fe_{16}Co_xNi_{34-x}Ge_7Si_{27}$（x=1，3，6，7.5，9）series alloy were prepared by vacuum arc melting technology under the protection of argon flow and structure and magnetocaloric effects of MnCoGe-FeNiSi composite material was investigated . Using X-ray diffraction (XRD) and vibrating sample magnetometer (VSM) method, structure and magnetocaloric effects of the alloys were analyzed, respectively. The results of the show that the alloys shift from low temperature type TiNiSi orthogonal structure into high temperature type Ni_2In single-phase hexagonal structure with the increase of the content of Co alloy. Alloys exhibit reversible FM-PM first-order phase transformation, with thermal hysteresis decreased from 13 K to 9 K and the Curie temperature though room temperature, and magnetic entropy change can reach 15.6 J／(kg·K) for 0~1.5 T.*

1 引言

磁致冷是利用磁工质的磁热效应，磁化时向外界放热，退磁时从外界吸热从而达到制冷的目的制冷技术。MnCoGe基合金作为新型磁致冷材料，广泛受到磁性材料研究者的关注。早在1953年，L. Castelliz报道了一类具有Ni_2In型六角结构的三元金属间化合物。1975年V.Johnson发现了MnCoGe的室温磁共结构相变行为。

2 实验方法

使用真空电弧熔炼炉，制备出$Mn_{16}Fe_{16}Co_xNi_{34-x}Ge_7Si_{27}$（x=1，3，6，7.5，9）系列合金。在1173 K下热处理168 h，自然冷却至室温。样品的物相结构用Philips P W 1830 X 射线衍射仪(XRD)分析。用美国 Lakeshore 7407 型振动样品磁强计（VSM）来