

Effect of Novolac wt.% on Rheological Properties of NBR/CR Blends

Ali I. Al-Mosawi

Faculty of Materials Science and Engineering
University of Miskolc
Miskolc, Hungary
alibrahim76@yahoo.com

Shaymaa Abbas Abdulsada

Faculty of Materials Science and Engineering
University of Miskolc
Miskolc, Hungary
shaymaa.radhi@uokufa.edu.iq

Mohammed H. Al-Maamori

College of Engineering Materials,
Babylon University
Babylon, Hilla, IRAQ
mat.mohammed.hamzah@uobabylon.edu.iq

Abstract

Rheological properties included viscosity and max torque of NBR/CR blends with different weight fraction of novolac nanoparticles (0- 40)wt.% were studied. Rheometer ODR 2000E device was used to measuring these rheological properties. The results shown that the novolac nanoparticles have a positive effect on viscosity and torque till the percentage 20 wt.% and then both of these properties begins to decline were.

Keywords

NBR/CR blends, Novolac nanoparticles, Rheological properties.

Introduction

Rheological properties have a considerable and important influence and through the stages of using of rubber material for many industries, because of their impact on the development of the fabricating and stability to operating of the product and performance in the final form [Malvern, 2016]. Many research studies have been achieved on the rheological properties of rubber as affected by fillers additions or working conditions [Al-Maamori et al, 2016]. Al-Maamori (2006) in his Ph.D thesis was investigated the mechanical and rheological properties of rubber parts fabricated from NBR with novolac and rice husk powder additions [Al-Maamori, 2006]. Al-Maamori, Al-Mosawi and Fasal (2012) studied the effect of adding shells powder (50,100,150 pphr) on viscosity and max torque of natural rubber [Al-Maamori et al, 2012]. Al-Maamori and Al-Mosawi (2014) in a patent have been studied the mechanical and rheological properties of rubber parts with different amounts from cement and rice husk waste [Al-Maamori, Al-Mosawi, 2014]. MALÁČ (2011) in his paper was calculated Mooney viscosity and Mooney relaxation data for various raw natural rubber grades [MALÁČ, 2011]. Zheleva (2013) published a research about the correlation between mooney viscosity vs. torque on a plasticorder for rubber compounds [Zheleva, 2013].

Materials and Methods

Acrylonitrile Butadiene Rubber (NBR), Chloroprene Rubber (CR), Novolac nanoparticles (1nm) were used in this paper which Mixed together with laboratory two roll mill type (Comerio Ercole Busto Arsizio) (see Figure1) as a two batches described in Table.1, first without novolac nanoparticles, and second with novolac additions. Samples of viscosity and torque were fabricated as a discs 40mm in diameter and 6mm in thickness by using hydraulic mould shown in Figure 2 with conditions 1.4 Mpa pressure and temperature 150°C. Rheometer ODR 2000E (Oscillating disc) shown in Figure 3, was used to estimate viscosity and torque according to (ASTM D1646-68) standard.

Table.1: Composition of batch No.1

Compounding Ingredients	Ratio, pphr	
	Batch.1	Batch.2
NBR/ CR	50/50	50/50
Novolac Nanoparticles	-	0-40
Zinc oxide	3	3
stearic acid	1	1
Dop	1	1
TMTD	1.5	1.5
Antioxidant	1.5	1.5
sulfur	1.5	1.5



Figure 1. laboratory two roll mill type (Comerio Ercole Busto Arsizio)



Figure 2. Hydraulic mould



Figure 3. Oscillating disc Rheometer

Results and discussion

Figure 4 and Figure 5 represents the relation between novolac nanoparticles additions as weight fraction with max torque and viscosity respectively. From these two figures we observed that the max torque and viscosity of NBR.CR blends will increase as the novolac nanoparticles percentage increases till weight fraction 20 wt.% and then have been decreased due to its plasticizing property which facilities the flowing of the blend inside the mould. This state is very important for blends to decrease the requirements for its forming [Al-Maamori, 2006].

CONCLUSION

From experimental results we found that the best additions from novolac nanoparticles is 20 wt.% which gives the optimum max torque and viscosity, and this is clear from the decrease in required torque for blends forming.

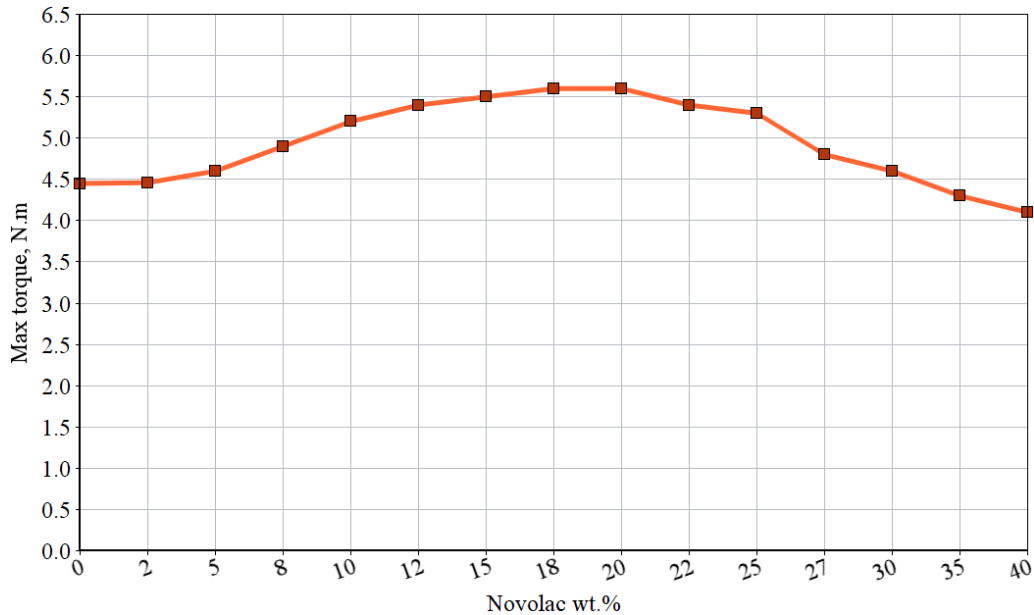


Figure 4. Max torque vs. novolac nanoparticles additions

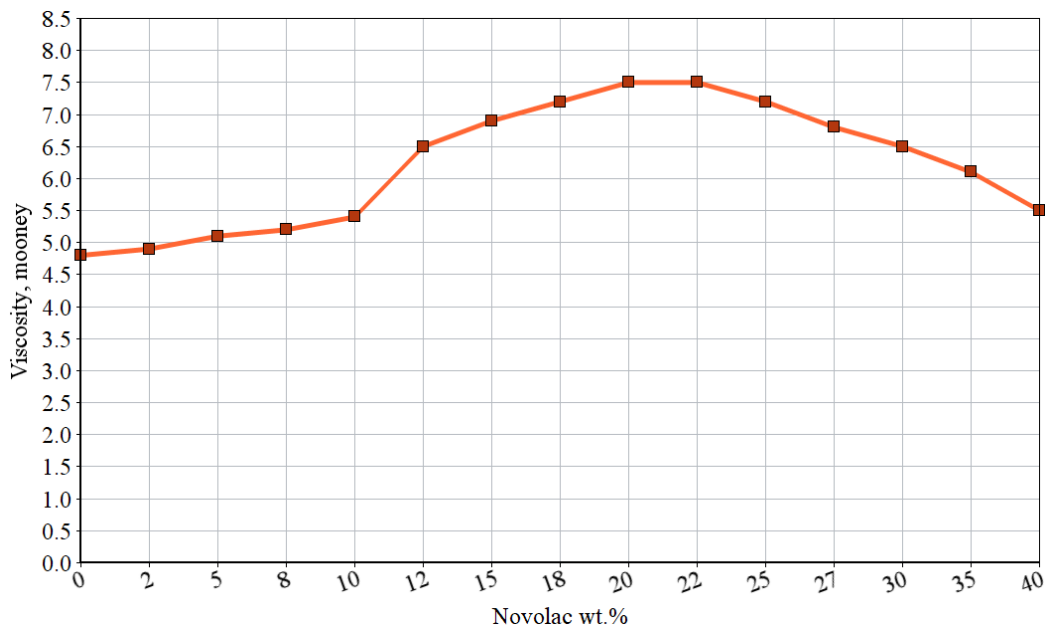


Figure 5. Viscosity vs. novolac nanoparticles additions

References

- Al-Maamori, Mohammed H., Al-Mosawi, *Manufacturing of composite rubber material for the manufacturing of rubber rubbles and other reinforced by a brass Bushes used in mechanical and electrical couplings*, Central Organization for Standardization and Quality Control (COSQC), International Classification (C08C19/42) , No.3913, Iraqi Classification (4) ,2014.
- Al-Maamori, Mohammed H., Al-Mosawi, Ali I., Fasal ,A., *Effect of adding shells powder on rheological properties of natural rubber*, Iraqi journal of Polymers, vol. 16, no. 1 , pp:71-74, 2012.
- Al-Maamori, Mohammed H., *Mechanical properties of polymeric composite materials*, Ph.D thesis, UOT, IRAQ, 2006.
- Al-Maamori, Mohammed H., Abdulsada, Shaymaa Abbas., Fasal ,A., *Rheological behavior of Rubber Blends*, International Journal of Engineering Technology, Management and Applied Sciences, vol. 4, Issue. 11 , pp:91-94, 2016.
- MALÁČ, JIŘÍ. *Mooney viscosity, mooney elasticity and procesability of raw natural rubber*, Journal of Materials Science and Engineering with Advanced Technology, vol. 3, no. 1 , pp:67-87, 2011.
- Malvern, *Rheology and Viscosity*, Malvern Instruments Ltd, 2016.
- Zheleva D., *An attempt for correlation between mooney viscosity and rheological properties of filled rubber compounds*, Journal of Chemical Technology and Metallurgy, vol. 48, no. 3, pp:241-246, 2013.

Biography

Mohammed H. Al-Maamori. Prof .Dr. in College of Engineering Materials, Babylon University,IRAQ.

Ali I Al-Mosawi holds a master's degree in Materials Engineering; and now a PhD. student in Faculty of Materials Science and Engineering, University of Miskolc, Hungary. He worked as Assistant Lecturer in University of Babylon/Iraq for the period May 2005-January 2006, and worked as a Lecturer in the Department of Mechanics/Technical Institute of Babylon for the period January 2006-May 2012. He also worked as a Lecturer at the Department of Machines and Equipments/Technical Institute of Babylon for the period May 2012- April 2014. He holds Editorial board member in scientific journals and Associations: International Journals of Engineering & Sciences (IJENS), International Journal of Technical and Research Applications, Open Journal of Functional Material Research, Research and Application of Material, Elixir International Journal, Topclass Journal of Engineering and Materials Sciences, International Journal of Multidisciplinary and Current Research (IJM CR), Journal of Materials & Metallurgical Engineering (JoMME), International Journal of Current Engineering and Technology, International Journal of Research in Mechanical Engineering, World Journal of Engineering and Physical Sciences, European Journal of Engineering and Technology (EJET), International Journal of Innovative Technology and Research, Asian Journal of Current Engineering & Math's [AJCEM], Scholars Journal of Engineering and Technology International Journal of Engineering Associates, Journal of Computing Technologies, Open Journal of Organic Chemistry, International journal of advanced and innovative research Advanced research in engineering sciences, Direct research journal of chemistry and material science Progressive Academic Publishing,UK., International Journal of Research in Mechanical Engineering, American Journal of Science and Technology, Journal of Medical Biomedical and Applied Sciences (JMBM), International Journal of Computer and Advanced Engineering Research (IJCAER), Advanced Research in Engineering Sciences, International Journal of Applied Science, Journal of Natural Sciences (JNS), Science and Technology journals, IOSRD International Journal of Engineering, International Association of Computer Science and Information Technology (IA CSIT), Science and Engineering Institute (SCIEI), World Academy of Science, Engineering and Technology (WASET), World Academy of Research in Science and Engineering (WARSE), International Society for Development and Sustainability (ISDS), International Institute of Chemical, Biological & Environmental Engineering (IICBEE) (Scientific Board of Chemical, Civil, Agricultural and Environmental Engineers), International Association of Engineers (IAENG), Scientia Research Library, IAENG Society of Chemical Engineering, IAENG Society of Industrial Engineering, IAENG Society of Mechanical Engineering, Industrial Engineering and Operations Management (IEOM) Society, Khawarizmi Science Society Iraqi Writers Union of the Internet, Iraqi Society of Professionals, Research Gate Network.

Shaymaa Abbas Abdulsada. holds a master's degree in Materials Engineering; and now a PhD. student in Faculty of Materials Science and Engineering, University of Miskolc, Hungary. She worked in Contracts Section advisory-Office of the province of Diwaniyah for the period September 2011 – January 2012, and worked as a Lecturer in the University of Kufa, Collage of Engineering, Department of Materials for the period February 2012-et. She is an Editorial board member in International Journals of Engineering & Sciences (IJENS), World Academy of Science, Engineering and Technology, Elixir International Journal and Industrial Science Journal. Also she holds Scientific Associations Membership in The World Academy of Research in Science and Engineering (WARSE), International Society for Development and Sustainability (ISDS), International Congress and International Association of Engineers (IAENG).