International Journal of Chemical Science
Online ISSN: 2523-2843, Print ISSN: 2523-6075; Impact Factor: RJIF 5.22
Received: 21-03-2020; Accepted: 07-04-2020; Published: 13-04-2020
www.chemicaljournals.com
Volume 4; Issue 2; 2020; Page No. 32-34

Role of transition metal nanoceramics in rubber degradation

Pranjali T Maskar[1*], Sanjay Bapurao Ghorpade[2]
[1] Assistant Professor, Department of Chemistry, B.K. Birla College of Arts, Science and Commerce (Autonomous), Kalyan, Maharashtra, India
[2] Research Scholar, Department of Chemistry, B.K. Birla College of Arts, Science and Commerce (Autonomous), Kalyan, Maharashtra, India

Abstract
Plasticizer used in rubber processing. Plasticizers increase the plasticity of plastic. Fuel oil itself acts as a plasticizer. It was observed there was huge loss of plasticizer during storage and transport. To prevent this difficulty or in order to increase the life of plasticizer, transition metal ceramics were added in it. Nanoeramics were prepared by combustion method in which oxalic acid is fuel and nitrate salts of metal were self-oxidizing agents. It was notified that flash point of plasticizer increased significantly and viscosity of oil little decreased. Thermal stability, storage and transport quality of plasticizer was improved due to incorporation of transition metal ceramics in plasticizer. As a result thermal stability of rubber enhanced. Loss of rubber due to high temperature was prevented, hence degradation reduced. It was found that plasticizer (fuel oil) recovered after pyrolysis process and by products was minimized due to the nanoceramic powder.

Keywords: Nitrate salts of nickel and cobal. oxalic acid, plasticizer (fuel oil)

1. Introduction
Fluidity of the plastic was generated in Al_2O_3 at all strain rates if confinement is sufficient to prevent premature failure via microfracture. The role of plasticity as a limiting factor in the compressive failure of high strength ceramic [1].
The study of composites of chloroprene rubber and ceramic particles of PZT or $PbTiO_3$ was recently reported. The dielectric constant and piezoelectric constants of above material was reported [2]. Polyethylene glycol was acts as new plasticizer. It was also known as PEG –borate. Solid polymer electrolyte composed of poly (ethyleneglycol) methacrylate (PEGMA) and lithium bis-trifluoromethanesulfonimide (LiTFSI) was incorporated with PEG –borate. The PEG-borate ester shown good thermal stability and high flash point. Ionic conductivity of the polymer electrolyte increased with increasing amount of the PEG-borate ester and exhibited values greater than 10−4 S cm−1 at 30 °C and 10−3 S cm−1 at 60 °C [3]. The binder composition used for ceramic injection molding played a crucial role on the final properties of sintered ceramic and to avoid defects on green parts. That study proposes a new eco-friendly binder based on natural rubber as a backbone polymer for ceramic injection molding of alumina. Three binders with different content of natural rubber and paraffin wax have been investigated [4].
In the Roles of Poly (propylene glycol) during Solvent- Based Lamination of Ceramic Green tapes, I t was observed that determine the role of propylene glycol in the lamination process and, specifically, the mechanism by which it is redistributed during subsequent processing. PPG slowly diffuses through the organic binder film at room temperature [5].
After recycling (pyrolysis) process conversion to waste tyre to fuel was successfully done.
The tyre to oil recycling process was the process of cracking waste tires and waste rubber into fuel oil and gas by using chemical pyrolysis principle.
Waste tire—-Hook wire drawing machine–tire cutting machine–tire shredder — belt conveyor–Reactor–pyrolysis oil/carbon black/steel wire /Combustible gas [6].
It was found that an excellent plasticizer for rubber, rubber mixtures and rubber-like masses was a polymerized essentially hydrocarbon product arising from the high-pressure polymerization of cracked gasolines, (fuel oil) preferably in the presence of a contact mass, such as diatomaceous earth. When this polymerization is carried on at between 450° F. and 750° F., a polymerized product was obtained which mills readily with rubber to form an easily workable mass which was more or less tacky, depending on the ratio of rubber to polymer [7]. A general theory was developed which enables closed- cup flash- points of mixtures of flammable and non- flammable liquids to be predicted from a knowledge of certain properties of a flammability diagram. and ables flash point apparatus was widely used to mesure the flash point of oils, plasticizers [8].
Redwood viscometer was selected to measure the viscosity of plasticizer or oil.It was also selected for a calibration because there appeared to be some doubts whethere or not the instrumental constants varied with the temperature [9].
Novel combustion synthesis method has been developed to prepare electronic ceramic oxide powders—Ni0.5Zn0.5Fe_2O_4, ZnO, $LiCoO_2$, $BaFe_{12}O_{19}$ and $YBa_2Cu_3O_7{-}x$ (x≦0.25). Organic compounds (e.g., glycine, urea, citric acid, alanine, or carbohydrazide) to be mixed directly with metal nitrates without adding water, was the key technique of that method [10].

2. Objectives
- To prepare the transition metal ceramics by combustion method.

- To investigate the effect of transition metal ceramics on the stability of rubber.
- To investigate the effect of ceramics on the flash point of plasticizer.
- To study the change in viscosity of plasticizer due to ceramics.

3. Experimental Details

Ceramics were developed by various chemical methods. Out of all chemical methods, gel- combustion method is suitable for lustrous, uniform development of metal ceramic particles.

Equi -molar quantities of nitrate salts of cobalt and titanium were dissolved in aqueous medium and suitable solvent (oxalic axid) is added in it. The mixture is heated on the heating mantle for 2 hrs up to its melting point. After that it was found that semi solid mass developed inside the beaker. After continuous mixing and stirring the mixture (precursor), particle size of ceramics was reduced. By maintaining the temperature parameter as a constant throughout the experiment, gel is ignited to combust, yielding a voluminous and fluffy product with large surface area at a particular temperature. (avoiding the explosion)

Homogeneous, uniform powdered metal nanoceramic powder is kept in hot air oven for 1 hr. at temperature 150^{o}c.Grey coloured, lustrous uniform ceramic powder is developed. I n this process oxalic acid is combustible compound and nitrates is self-oxidising compound.

In order to enhance the properties of plasticizer (fuel oil), metal nanoceramics is added in the plasticizer. It was noticed that flash point of plasticizer increased significantly and little effect on viscosity. With help of abel's flash point readings of flash point taken. By using redwood viscometer viscosity measured in redwood second.

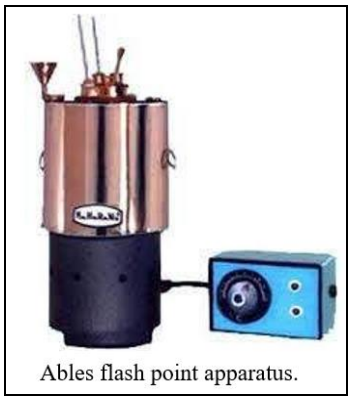

Fig 1

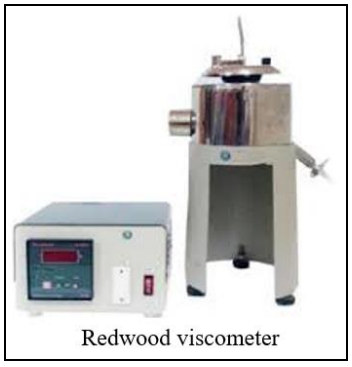

Fig 2

Fig 3

Fig 4

Following observation table showing the flash point of plasticizers in ^{O}C Observations: Table 1

Table 1

Sr.no.	Flash point of plasticizers (^{O}C)	Flash point of plasticizer+ ceramics (^{O}C)	Stability	Flash point of plasticizer (^{O}C)	Flash point of plasticizer+ ceramics (^{O}C)
1	66.6	75.2	First hr	66.6	75.2
2	66.5	75.2	Second hr.	66.5	75.2
3	66.5	75.3	Third hr	66.5	75.3
4	66.5	75.6	Fourth hr.	66.5	75.5
5	66.5	75.4	Fifth hr	66.5	75.4
6	66.3	75.5	Sixth hr.	66.3	75.7
7	66.4	75.5	Seventh hr.	66.4	75.9

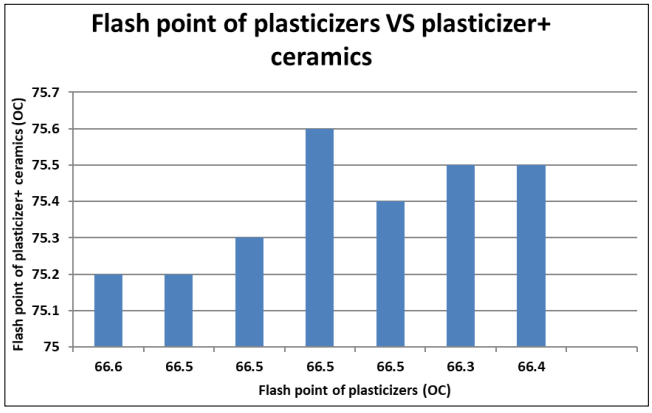

Fig 5

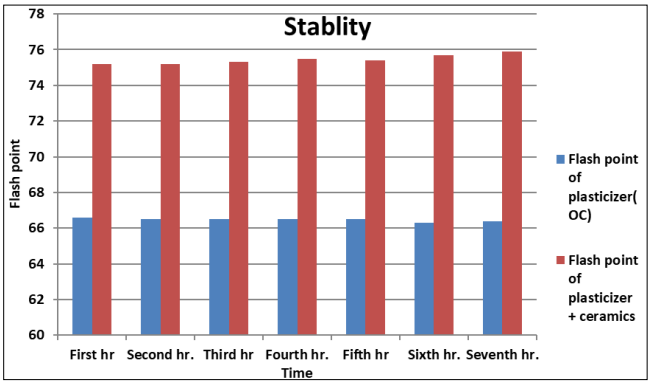

Fig 6

Following table shows viscosity of oil in redwood second with temperature:

Table 2

Temp in °c	Viscosity of plasticizer oil	Viscosity of plasticizer with ceramic powder	
		ceramics with plasticizer (blend -1)	ceramics with plasticizer (blend -2)
30	1310	1312	1311
40	1140	1145	1146
50	780	785	788
60	385	386	387
70	295	298	299
80	205	210	212
90	75	77	78

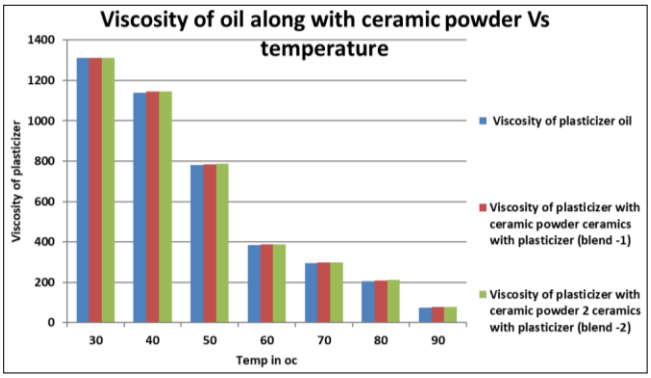

Fig 7: Viscosity of oil along with ceramic powder Vs temperature

4. Results and Discussion

With increase in temperature, decreased the viscosity of plasticizer incorporated ceramics. That indicates, at high processing temperature, rubber was retained their properties. Flash point of plasticizer is increased after addition of ceramics in it due to that metal ceramics enhances the thermal property of plasticizer hence there is no loss of rubber at elevated temperature.

5. Conclusion

- By gel combustion method, lustrous ceramic powder is developed.
- Transition metal ceramics increased the thermal stability of the rubber
- Ceramics enhanced the flash point of plasticizer.
- Viscosity of the plasticizer is moderated due the transition metal ceramics.
- Loss of plasticizer as well as rubber is reduced due to metal ceramics.

References

1. Lankford J, Predebon WW, Staehler JM, Subhash G, Pletka BJ, Anderson CE, et al. The role of plasticity as a limiting factor in the compressive failure of high strength ceramics. Mechanics of Materials. 1998; 29(3-4):205-218.
2. Banno H. Recent developments of piezoelectric ceramic products and composites of synthetic rubber and piezoelectric ceramic particles. Ferroelectrics. 1983; 50(1):3-12.
3. Kato Y, Hasumi K, Yokoyama S, Yabe T, Ikuta H, Uchimoto Y, et al. Polymer electrolyte plasticized with PEG-borate ester having high ionic conductivity and thermal stability. Solid State Ionics. 2002; 150(3-4):355-361.
4. Escobar CF, dos Santos LA. New eco-friendly binder based on natural rubber for ceramic injection molding process. Journal of the European Ceramic Society. 2015; 35(13):3567-3575.
5. Suppakarn N, Ishida H, Cawley JD. Roles of Poly (propylene glycol) during Solvent- Based Lamination of Ceramic Green Tapes. Journal of the american ceramic society. 2001; 84(2):289-94.
6. https://www.bestonmy.com/recycling-plant/tyre-recycling/. Tyre recycling to plant oil.
7. Julius H, VELSICOL CORP. Rubber plasticizer. U.S. Patent 2,008,102, 1935.
8. Thorne PF. Flash points of mixtures of flammable and non- flammable liquids. Fire and Materials. 1976; 1(4):134-140.
9. Herschel WH. The redwood viscometer (No. 210). US Government Printing Office, 1922.
10. Hwang CC, Wu TY, Wan J, Tsai JS. Development of a novel combustion synthesis method for synthesizing of ceramic oxide powders. Materials Science and Engineering: B. 2004; 111(1):49-56.