Investigation on hBN Nanoparticle dispersion stability in liquid phase with difference dispersion agents

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ABSTRACT – The aims of this study is to investigate the effect of difference surfactant agent for better dispersion of hBN solid nanoparticles inside the liquid phase. A set of sample was prepared by using ultrasonic homogenizer. Three types of surfactant agent were used which are Sodium Cholate, Oleic acid and Sodium Benzene Dodecyl Sulphonate (SDBS). The absorbance values of the nano-oil were measured using UV-spectrometer. The result shows that suspension of conventional engine oil SAE 15W-40 with the addition of hBN nanoparticles and surfactant agent of SDBS manage stable over the period of 56 days.

1. INTRODUCTION

Today, a lubricant is the most important things for any machinery parts that appearing in this world. The main features of lubricant are to controls resistance and friction between surfaces through supplying a durable film [1]. Even though lubricant can help reduce the friction and wear, lubricant still have their disadvantageous which is it will degrade and deteriorate very rapidly in some operating conditions. According to recent numerous studies [2-4], the nanotechnology can indeed improve the lubrication properties oils. By mixing lubricant with nanoparticles (additives) it can maximizing the performance of the lubricant. Nanoparticles did not dissolve with lubricant. As reported by Yu and Xie [2] the agglomeration of nanoparticles resulting not only on the settlement and clogging of micro-channels but also the decreasing of thermal conductivity of nano-lubricant.

Addition of dispersants agent inside the oils with mixed of nanoparticles is an easy and economic method to enhance the stability of nano-oil [3]. According to Paramashivaiah and Rajashekhar [4] the use of surfactant agent is to provide an effective and efficient coating to induce electrostatic or steric repulsions that can counterbalance van der Waals attractions and also give better dispersion on the nanoparticles additive inside the oil [5]. The uncontrolled factor for the dispersion stability of nanoparticle in the lubricant is the sedimentation. Sedimentation means settling of particle or floccules occur under gravitational force in liquid dosage form. To decrease the sedimentation, the dispersion or suspension agent must be added into the lubricant. Furthermore, this both agents also can help to increase the stabilization of nano-lubricant and enhance the thermal conductivity. Therefore, it is importance to investigate the effect of difference surfactants agent of the nano-oil sample on the stability of nanoparticles. The stability of nano-oil will be evaluated using quantitative and qualitative analyses.

The objective of this studies is to investigate the effect of different surfactant agent and suspension agent for better dispersion of solid nanoparticle inside the liquid phase condition.

2. METHODOLOGY

A set of sample was prepared according to the Table 1 with an optimal composition of 0.5 vol.% hBN nanoparticles in SAE 15W-40 conventional engine oil and with addition 0.3 vol.% surfactant agents as a nano-oil. The samples were mixed using ultrasonic homogenizer (Sartorius Labsonic P) with 50% amplitude and 0.5 active time interval as shown in Figure 1. The absorbance value was recorded for approximately two months by using UV-Spectrometer and the image of samples sedimentation was captured.

Table 1 Sample preparation.

Test No.	Factor		
	Surfactant	**Nanoparticle**	**Homogenize time (minutes)**
1	Oleic acid		
2	Sodium cholate	hBN	30
3	SDBS		

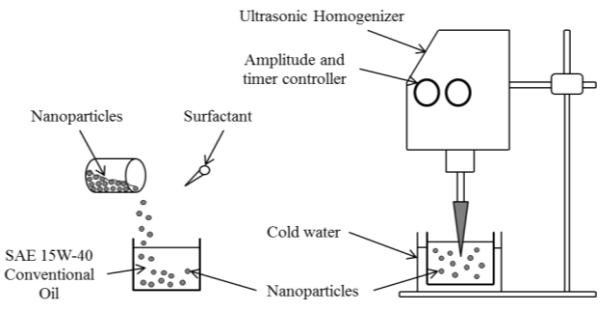

Figure 1 Schematic diagram sample preparation by using ultrasonic method.

3. RESULT AND DISCUSSION

Table 2 shows picture of nano-oil dispersed with SDBS, Sodium Cholate and Oleic acid for approximately two months. Based on the image observation, there are no changes occur from the 1st day until the 4th day for SDBS agent compared to Sodium Cholate and Oleic acid. The changes can be seen after a week which the colour of the oil sample become pale yellow compare to the image in the previous day. According to Rosicka and Sembera, [3] due to attractive magnetic forces, the rate of aggregation is significantly higher, whereas the repulsive electrostatic forces are almost negligible which it can resulting in occurring of sedimentation process. The stability trend for overall 56 days of surfactant agent shows in Figure 2, where the higher absorbance obtained by SDBS agent.

Table 2 Nano-oil with SDBS, Sodium Cholate and Oleic acid.

Picture of SAE 15W 40 + Additive + Surfactant

Days	abs	SDBS	abs	Sodium Cholate	abs	Oleic acid
1	3.984		3.385		3.999	
2	3.981		3.325		3.989	
3	3.784		3.320		3.892	
4	3.705		3.289		3.789	
7	3.689		3.282		3.690	
8 (Week 1)	3.681		3.099		3.644	
15 (Week 2)	3.536		3.011		3.587	
22 (Week 3)	3.515		2.986		3.237	
28 (1 Month)	3.461		2.959		3.206	
56 (2 Month)	3.1953		2.761		3.110	

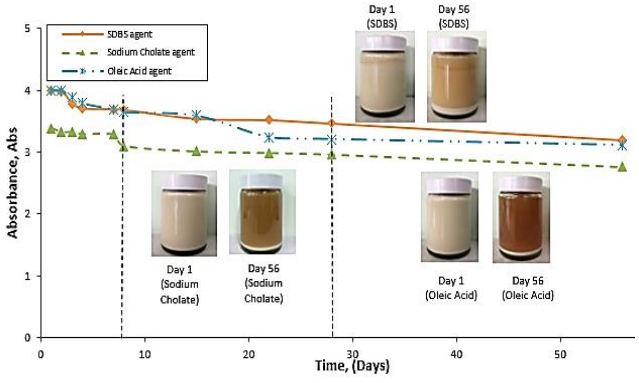

Figure 2 Comparison of SDBS, Sodium Cholate and oleic acid stability for 56 days.

SDBS commonly used inside washing detergent, which the main purposed is to disperse the liquid detergent from liquid separation. In primary conclusion, the electrostatic mechanism between the SDBS and hBN nano particles maybe increase the repulsive force and result in thicken the electrical double-layer that provides more dispersion stability. By referring to main function of SDBS agent, there are possibility that SDBS can improve the stability of the nano-oil which resulting to highest absorbance value until 56 days. Further investigation on the intermolecular reaction between the SDBS and hBN maybe key factor for the success of the nano-oil stability which not going to be discuss here.

4. CONCLUSION

As conclusion, the result shows that the effect of SDBS agent towards hBN nanoparticles in nano-oil is more stable compare to Sodium Cholate and Oleic acid. The electrostatic mechanism which increase the repulsive force and result in thicken the electrical double-layer that provides dispersion stability maybe the key solution for future work.

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