Pengaruh penambahan surfaktan sodium dodecyl benzene sulfonate dan polyethylene glycol serta konsentrasi reduced graphene oxide terhadap stabilitas dan konduktivitas termal fluida terdispersi partikel mikro = The influence of sodium dodecyl benzene sulfonate and polyethylene glycol and concentration of reduced graphene oxide on the stability and thermal conductivity of microparticles-dispersed fluids

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Abstrak

Fluida yang terdispersi partikel grafena banyak diteliti karena grafena memiliki konduktivitas termal yang sangat tinggi (±5000 W/mK). Namun grafena memiliki kelemahan berupa sintesisnya yang sulit dan buruknya tingkat dispersitas dalam air. Oleh karena itu, pada penelitian ini digunakan partikel reduced Graphene Oxide (rGO) yang memiliki struktur seperti grafena, tetapi tingkat dispersinya lebih baik dan sintesisnya tidak sesulit grafena. Dalam fluida juga ditambahkan surfaktan Sodium Dodecyl Benzene Sulfonate (SDBS) dan Polyethylene Glycol (PEG), untuk meningkatkan tingkat kestabilan rGO, sehingga peristiwa aglomerasi dapat dihindari. Proses sintesis rGO dimulai dari oksidasi grafit menjadi Graphene Oxide (GO) menggunakan metode Hummers termodifikasi. Lalu GO direduksi menjadi rGO menggunakan reduktor kimia hidrazine. Setelah itu, partikel dikarakterisasi menggunakan Energy Dispersive Spectroscopy (EDS), Scanning Electron Microscope (SEM), dan X-Ray Diffraction (XRD), untuk memastikan struktur rGO berhasil didapatkan. Kemudian partikel rGO dengan variabel konsentrasi 0.01, 0.03, 0.05% Wt, serta surfaktan SDBS dan PEG sebanyak 10% Wt didispersikan dalam 100 ml akuades menggunakan proses ultrasonifikasi selama 3 jam. Fluida terdispersi partikel mikro rGO kemudian dikarakterisasi dengan pengujian Particle Size Analyzer (PSA) dan Potensial Zeta untuk mengetahui distribusi ukuran dan tingkat kestabilannya. Nilai konduktivitas termal fluida terdispersi partikel mikro rGO dihipotesis melalui perbandingan berbagai literatur dan analisis pengujian yang telah dilakukan. Hasilnya, penambahan rGO dengan konsentrasi 0.01, 0.03, dan 0.05% Wt akan menghasilkan fluida dengan stabilitas yang cukup baik, karena adanya gugus oksigen yang tersisa pada rGO. Komposisi penambahan optimum untuk meningkatkan nilai konduktivitas termalnya adalah 0.05% Wt. Penambahan surfaktan sebanyak 10% Wt meningkatkan stabilitas fluida, dibuktikan melalui meningkatnya nilai potensial zeta. Walaupun penambahan PEG menurunkan potensial zeta, stabilitas fluida meningkat melalui fenomena steric hinderance. Penambahan surfaktan sebanyak 10% Wt akan menurunkan konduktivitas termal fluida karena meningkatkan viskositas dan resistansi termalnya, serta surfaktan sendiri memiliki konduktivitas termal yang buruk. Dibandingkan surfaktan jenis non-ionik, surfaktan jenis anionik seperti SDBS lebih cocok untuk mendispersikan rGO dan dapat meningkatkan konduktivitas termal fluida pada komposisi penambahan yang tepat.

......Fluids that were dispersed by graphene particles have been widely studied since graphene has very high thermal conductivity (5000 W/mK). However, graphene has disadvantages such as its difficulty to be synthesized and has poor level of dispersity in the water. Therefore, in this study, the use of reduced Graphene Oxide (rGO) particles will be explored. rGO has similar structure as graphene, but it has better dispersity in water and its method of synthesis is not as difficult as graphene. Furthermore, the addition of Sodium Dodecyl Benzene Sulfonate (SDBS) and Polyethylene Glycol (PEG) will be studied, to further increase the stability of rGO in water, so that the agglomeration can be avoided. Graphite was oxidized into Graphene Oxide (GO) using modified Hummers method. Then GO was reduced to rGO using hydrazine as the reducing agent. After that, rGO particles were characterized using Energy Dispersive Spectroscopy (EDS), Scanning Electron Microscope (SEM), and X-Ray Diffraction (XRD), to ensure the structure of rGO was obtained. Afterwards, rGO particles with concentration variable of 0.01, 0.03, 0.05% Wt and 10% Wt of SDBS or PEG were dispersed in 100 ml of distilled water, using ultrasonication process for 3 hours. rGO-dispersed Fluids then characterized using Particle Size Analyzer (PSA) and Zeta Potential measurement to determine its size distribution and rGO stability in water. The value of rGO-dispersed fluids thermal conductivity will be hypothesized through the comparison of various literature. As a result, the addition of 0.01, 0.03, and 0.05 %Wt rGO would produce fluids with good stability, due to the presence of oxygen functional groups that remain in the rGO structure. The optimum concentration of rGO to enhance the value of fluids thermal conductivity is 0.05 %Wt. The addition of surfactants as much as 10 %Wt increase the stability of rGO-dispersed fluids, which showed through the increased value of zeta potential. Although the addition of PEG decreased zeta potential, the rGO-dispersed fluids stability was increased through the phenomenon of steric hinderance. The addition of surfactants as much as 10 %Wt will decrease the rGO-dispersed fluids thermal conductivity, since it increases the viscosity and thermal resistance, as well as the surfactant itself has poor thermal conductivity. Compared with non-ionic type surfactant, anionic type surfactants, especially SDBS, is more suitable for dispersing rGO in water. However, it could only improve rGO-dispersed fluids thermal conductivity if the addition of surfactants is optimum and appropriate.</div>