EFFECTS OF SOME MONOMERIC AND POLYMERIC ADDITIVES ON THE RHEOLOGICAL PROPERTIES OF AQUEOUS COLLOIDAL SUSPENSIONS OF TITANIUM DIOXIDE (TiO₂) AND ZIRCONIUM DIOXIDE (ZrO₂)

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ABSTRACT

Rheological properties (in particular, the yield stress and to a smaller extent, the viscosity) of zirconium dioxide, ZrO₂ and titanium dioxide, TiO₂ aqueous suspensions in some monomeric and polymeric additive solutions at various concentrations were measured at various pH. The additives are categorized into four groups as follows:

i) Cyclohexane multi carboxylic acids comprising cis-1,2-cyclohexanedicarboxylic acid, trans-1,2-cyclohexanedicarboxylic acid, trans-1,4-cyclohexanedicarboxylic acid, 1,3,5-cyclohexanetricarboxylic acid, disodium salt of ethylenediamine tetraacetic acid (EDTA) and 1,2,3,4,5,6-cyclohexanehexacarboxylic acid.

ii) Amphoteric amino acids comprising glycine, iminodiacetic acid (IDA), disodium salt of nitrilotriacetic acid (NTA), DL-aspartic acid and EDTA.

iii) Copolymers comprising the disodium salt of α-methyl styrene maleate copolymer and disodium salt of diisobutylene maleate copolymer.

iv) 2-hydroxyethyl cellulose of molecular weights 15 000, 90 000 and 720 000 Dalton.
In general, the effects of additives on the increase or decrease of the maximum yield stress and the shift of the pH of the maximum yield stress are quite similar for both types of suspensions except for the followings:

i) the inability of the TiO$_2$ suspension to reach complete dispersion at basic pH end in the absence and presence of additives (except when 0.1 and 0.5dwb% cis-cyclohexanehexacarboxylic acid were used)

ii) in the presence of hydroxyethyl cellulose ($M_w$ 15 000), ZrO$_2$ suspension cannot form a stable dispersion as sedimentation occurs soon after sonication.

Various interparticle forces have been invoked to explain the yield stress-pH and viscosity-pH behaviour.
ABSTRAK

Sifat-sifat reologi (secara khusus, tegasan alah dan sedikit sebanyak mengenai kelikatan) bagi penyerakan akues zirkonium dioksida, ZrO$_2$ dan titanium dioksida, TiO$_2$ dengan kehadiran berbagai jenis larutan ‘additives’ monomerik dan polimerik dalam berbagai kepekatan telah diukur pada berbagai pH. ‘Additives’ yang digunakan telah dibahagikan kepada empat kumpulan seperti berikut:

i) Kumpulan multi karboksilik asid yang dianggotai oleh sis-1,2-sikloheksanedikarboksilik asid, trans-1,2-sikloheksanetikarboksilik asid, trans-1,4-sikloheksanedikarboksilik asid, 1,3,5-sikloheksanetrikarboksilik asid, garam disodium bagi etilendiamine tetraacetik asid (EDTA) dan sis-sikloheksaneheksakarboksilik asid.

ii) Kumpulan amfoterik amino asid yang dianggotai oleh glisin, iminodiacetik asid (IDA), garam disodium bagi nitrilotriasletik asid (NTA), DL-aspartik asid dan EDTA

iii) Kumpulan kopolimer yang dianggotai oleh garam disodium bagi $\alpha$-metil stiren maleate kopolimer dan garam disodium bagi diisobutilen maleate kopolimer

iv) Kumpulan 2-hidroksietil sellulosa dengan jisim molekul relatif 15 000, 90 000 dan 720 000
Secara am, kesan ‘additive’ terhadap tren tegasan alah maksimum dan peralihan pH tegasan alah maksimum adalah lebih kurang sama bagi kedua jenis penyerakan kecuali berikut:

i) ketidakupayaan penyerakan TiO₂ untuk mencapai penyebaran penuh di pH basik hujung dengan ketidakhadiran dan kehadiran ‘additives’ (kecuali apabila 0.1 dan 0.5dwb% sis-sikloheksaneheksakarboksilik asid telah digunakan)

ii) dengan kehadiran 2-hidroksietil sellulosa (jisim molekul relatif 15 000), penyerakan ZrO₂ tidak dapat menghasilkan satu penyebaran yang stabil kerana pemendakan berlaku sebaik sahaja dialihkan daripada ‘sonication’.

Berbagai daya serakan koloid telah digunakan untuk menjelaskan berbagai kelakuan tegasan alah-pH dan kelikatan-pH.
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