STUDY ON TITANIUM CATECHOLATE OLIGOMER AS THIN FILM COATING MATERIALS USING VEGETABLE OILS

PhD (DISSERTATION)

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NOVEMBER, 2005

ABSTRACT

A hybrid inorganic/organic sol-gel precursor, titanium catecholate oligomer was prepared and characterized. Its feasibility as a thin film coating material was also studied by using sunflower, soyabean and kanzwe vegetable oils as alkyds vehicles. The oligomer with a percent yield of 73.28% was synthesized from titanium tetraisopropoxide and catechol using isopropanol as solvent and triethylamine (TEA) as an additive. The study was made by using mole ratios of titanium tetraisopropoxide and catechol with and without an additive. Based on elemental composition, the most probable empirical formula envisaged was $[Ti_2C_{24}H_{36}O_8]_n$ pertaining to the monodentate empirical formula of $[Ti_1C_{12}H_{18}O_4]$ based on atomic ratios. The compound prepared without an additive, shows nearly the same yield 73% and similar on elemental composition. Hence, it indicates the same general empirical formula. The difference between the oligomer prepared by using with additive and without additive lies in the morphological features revealed by SEM and Electromicroscopic photographs.

FTIR, UV and GC-MS data indicate it to be the unique inorganic/organic hybrid moiety. In pH and solubility in polar organic solvent showed the moiety was not only slightly acidic but also partially polar. XRD analyses indicate the oligomer to be amorphous; at 450°C it was converted to anatase and 900°C to rutile crystalline form. From TG/DTA thermal analysis, the hybrid was thermally stable up to 240°C. DSC analysis indicates glass transition temperature at 86.75°C and its melting point to be at about 234°C.

The hybrid oligomer titanium catecholate was found to be an effective coating material when mixed with blown up alkyds (vegetable oils: sunflower, soyabean and kanzwe). Coating properties such as thermal stability, solubility, hardness (scratch resistance, pencil hardness and microhardness), adhesion, heat treatment, weather resistance and conductivity were available as a function of alkyds type and sol-gel precursor content. The alkyds properties in term of drying index, when determined indicate that sunflower and soyabean can be categorized

as drying oil and kanzwe oil as non drying oil. The calculated drying index of sunflower and soyabean oils were found to be over 65 and that of kanzwe oil was found below 50.

The physicomechnical and coating properties of the products using sunflower oil and soyabean oils were high in quality than kanzwe oil. The film formed by using blown up sunflower and soyabean oils were also of high quality regarding the specific physicochemical and mechanical properties.

It can be summarized that the titanium catecholate oligomers prepared by using an additive (TEA), produce quality thin film coating than without using an additive. Furthermore, the coated thin film by using 15wt% titanium catecholate oligomer with the alkyds blown up sunflower and soyabean oils were found to produce a very high quality thin film compared with kanzwe oil. It was found that 1½ hr of blowing time, blown up oil was able to produce texturally harder and aesthetically smoother thin film coating.

Keywords: *hybrid inorganic/organic titanium catecholate oligomer, additive, thin film coating, alkyds (blown up vegetables oils)*