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# Effect of Zinc Oxide Nanoparticles on Anti-ageing Properties of Saturated Polyester Resin Based Coating.

**N. P. Badgujar[1], Y. P. Shirsath[2], R. D. Kulkarni[3], T. D. Despande[4]**

University Institute of Chemical Technology, North Maharashtra University Jalgaon 425001- MS India [1, 2, 3, 4]

***Abstract***

*Nanotechnology is considered to be one of the most important future technologies and is currently enabling evolutionary changes in almost all technological sectors. Coating sector is one of the biggest beneficiaries of this technology. Today, coating not only serves the purpose of beautification but also a means to protect valuable metals and buildings from corrosion. The availability of varieties of nanomaterials, various method of assembly and application of nanomaterials, the understanding of interaction parameters, the tailoriability of materials to suit for specific purpose, and self assembly behavior, high surface area to volume ratio and quantum effect of nanoparticles have been the key to success and holds promise for future applications. This overview is the technological survey to differentiate micro particles and nanoparticles, along with importance, synthesis, and application of nanoparticles. It also discusses about the effect of ZnO nanoparticles on anti-aging properties of polyester coating.*

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*Keywords: Ultrasonication, ZnO nano particles, anticorrosive coating*

## 1. INTRODUCTION

Nanotechnology, which can control the composition of coating at a molecular level, also provides the logic of miniaturization. [1] Nanoparticles shows stronger tendency of aggregation with various surface structures and surface interactions.[2] New multifunctional coating properties can be improves by the addition of nano particles. [3] Enhancement of durability and appearance of metal oxide pigments particles such as TiO2 and ZnO with polymeric products. [4] Zinc oxide powder has long been utilized as anticorrosive coatings for various metals. Specific parts of coating system associated with different properties by using wet or solution based chemical methods with producing ZnO nanoparticles of various morphologies [5] at relatively low temperatures. [6]

The improvements of dispersion stability of the nanoparticles depend upon surface modification of nanoparticles. [7] The applications of zinc oxide powder are numerous, and the principal ones are summarized below. Most applications exploit the reactivity of the oxide as a precursor to other zinc compounds. For material science applications, zinc oxide has high refractive index, high thermal conductivity, binding, antibacterial and UV-protection properties. Consequently, it is added into various materials and products, including plastics, ceramics, glass, cement, rubber, lubricants, paints, ointments, adhesive, sealants, pigments, foods, batteries, ferrites, fire retardants, etc.

## 1. Experimental details

### 2.1 a Synthesis of ZnO Nano particles (Rods)

ZnO nano particles (Rods) were synthesized by using 0.01M Zinc acetate solution was stirred for 30 min at room temperature in 3-necked flask then add 0.01M Hexamethylene tetramine solution drop wise with uniform stirring & heat at temperature of $100^0$C for half an hour simultaneously allow it for reflux. After half an hour continuous stirring precipitated has been formed. Cool down it at room temperature. Precipitates were centrifuged & wash several times with double distilled water and dried it in oven.

Then 0.5 gm of ZnO nano particles is dispersed by using 20 mm probe ultrasonicator Crometech Model Taiwan 20 KHz frequency watt). The rated output power of ultrasound probe was 750 W (at 50 % amplitude, 375W) in 30 gm linseed oil with sufficient quantity of xylene to reduce the viscosity of linseed oil. The result of was characterized by AFM.

### 2.1 b. Dispersion of ZnO nano particles in saturated polyester resin

ZnO nano particles (Rods) with different concentrations are dispersed in 20 gm of saturated polyester resin by using 20 mm probe ultrasonicator and their various results were characterized.

**2.2. Characterization**

**1) AFM analysis:** The ZnO nano particles was characterized by atomic force microscope (AFM)

**Grain Analysis report of Height**

At threshold: 27.6580002483405 nm

Grains collected: 1578

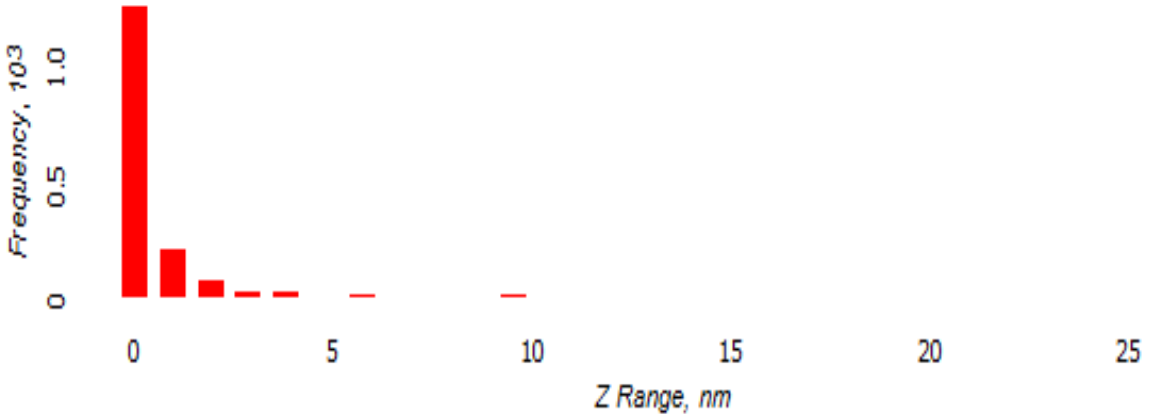


***Fig. 1 Histogram by Z Range***

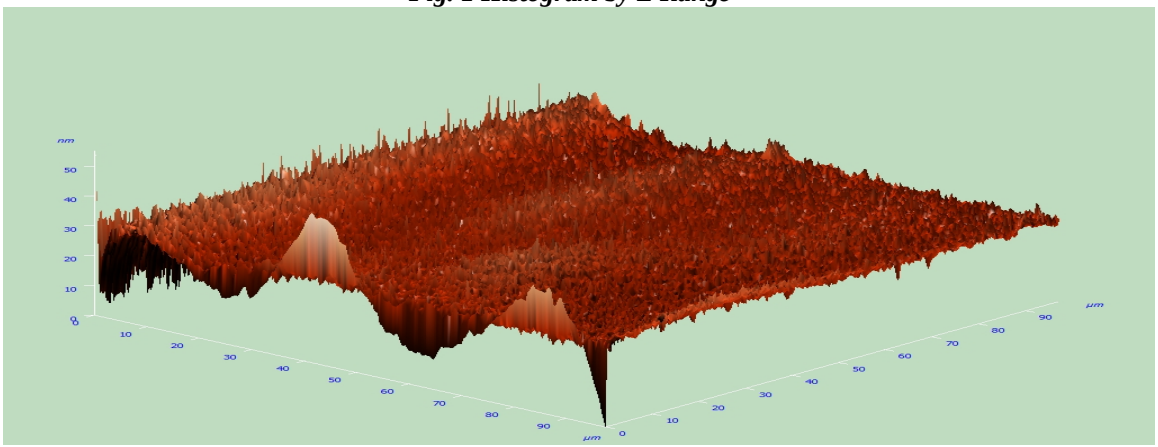

***Fig. 2 AFM analysis (3D image of ZnO nano particles)***

**2) Coating Characterizations:**

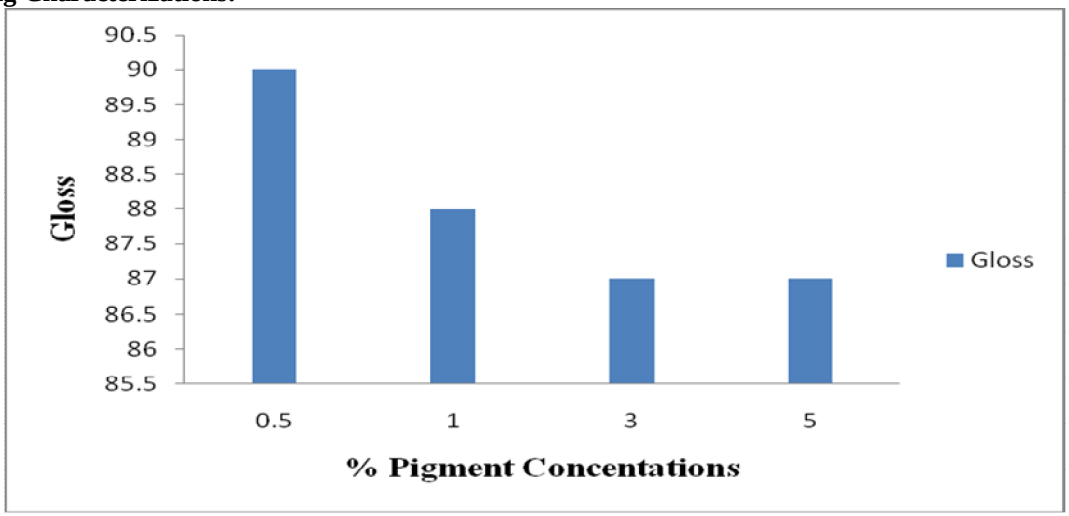


***Fig. 3 Gloss analysis***

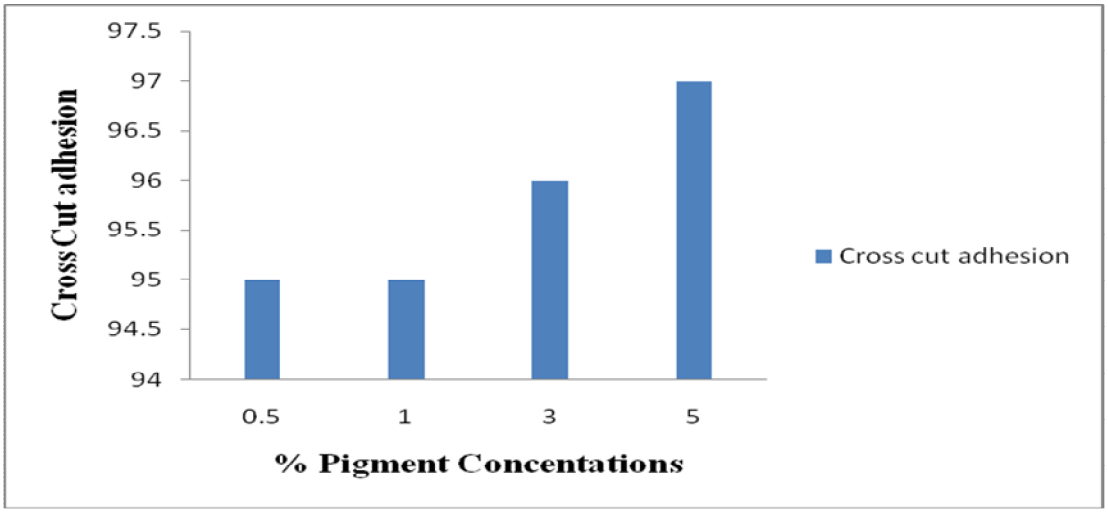


*Fig. 4 Cross cut adhesion*

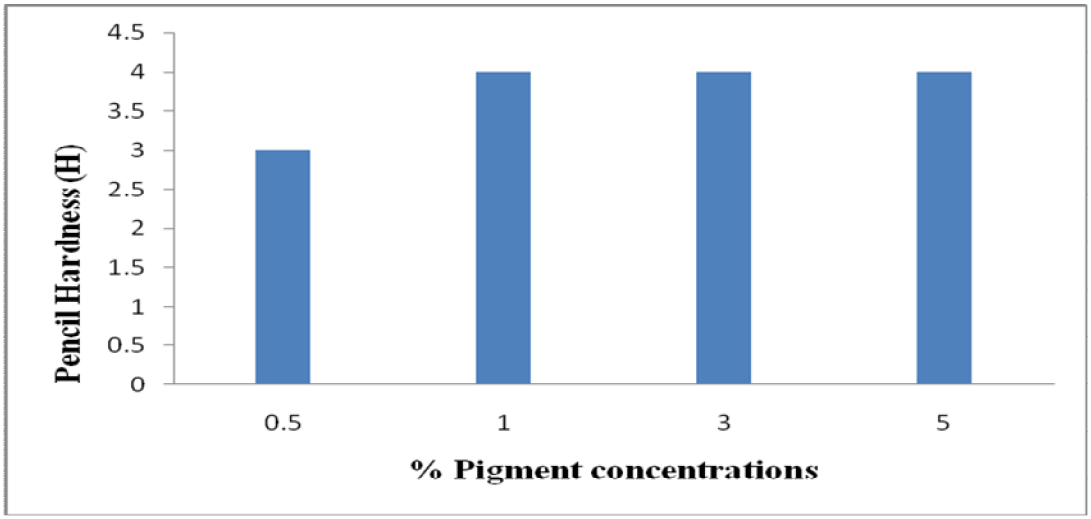


*Fig. 5 Pencil Hardmess analysis*

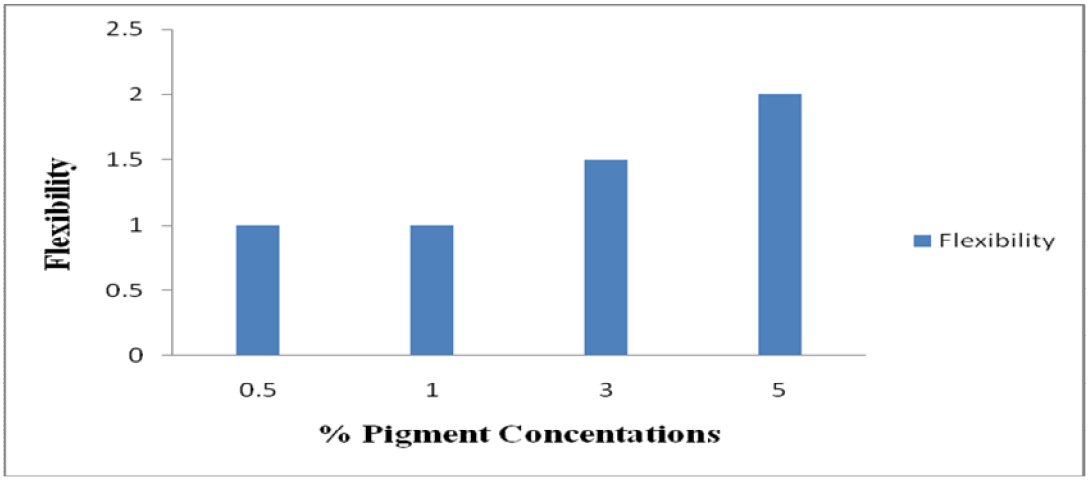


*Fig. 6 Flexibility*

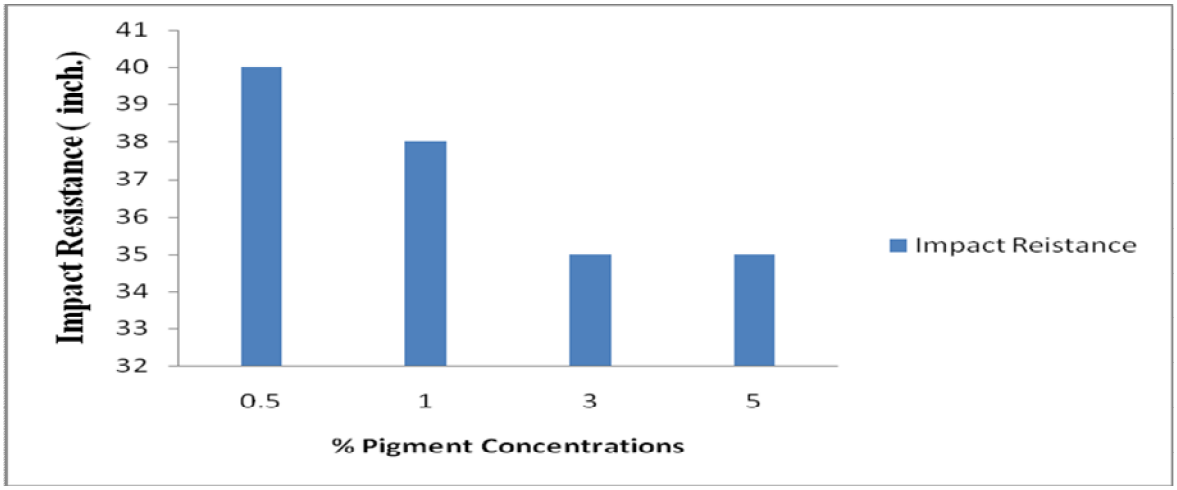


***Fig. 7 Impact Resistance analysis***

**Result and Discussion:**

[1] Figure 1 & 2 shows AFM analysis ZnO nanoparticles, Z range Histogram shows threshold value is 27.65 nm and 3D image shows that the ZnO nano particles are in well distributed form.

[2] Fig. 3. shows that the, 0.5% concentration has better gloss than 5 % concentration due to the low concentration of nano-pigments compatible with binder and forms smooth finish which reflects more than higher concentration based pigment.

[3] Fig. 4 & 5 indicates that the adhesion and pencil hardness of coating can greatly improves with increases the concentration of nano-particles due to the film becomes hard.

[4] Fig. 6 shows that the flexibility analysis, the 5% concentration based nano-particles shows higher flexibility than lower concentrations due to the more addition of nano particles the film becomes more elastic one.

[5] Fig. 7 indicates that the impact resistance of becomes decrease with increase in concentration of nano based particles is due to the development of film becomes more elastic but not hard due to the incompatibility with polymeric binder regarding hardness.

**Conclusions:**

[1] The use of 1% ZnO nano particles improves the performance of the coating than 5 % concentration ZnO nano particles.

[2] Dispersion of ZnO nanoparticles in polyester resin shows that increasing concentration of ZnO nanoparticles increases the weatherability but mechanical properties are disturbed.

[3] But 1% concentration ZnO nano particles show balance properties between weatherability and mechanical properties.

[4] Incorporation of Smaller concentration of ZnO nano particles in polymeric binder enhances the performance properties of coating.

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