Optimize particle suspension stability by the Hansen approach using the Turbiscan technology

PAINT & INKS

Introduction

Formulating stable particle suspensions is of great interest for academic and industrials as it allows to enhance the properties and the lifetime of their products. Industrial fields which are interested in suspension stability are numerous and extensive ranging from cosmetics and pharmaceutics to agriculture and energy. Overall, the choice of the stabilization medium is the key factor to avoid particle agglomeration before adding additives (surfactants, polymers, …etc.) which are, most of the time, quite expensive. Methods have been already developed to predict this stabilization medium such as the Hansen Parameters (HP). The aim of this note is to demonstrate that accurate determination of the HP of particles, Titanium Dioxide (TiO_2) in this study, can be obtained using the Turbiscan technology. Knowing the HP of particles, it is quite easy to predict greener and cheaper solvents to optimize particles formulation regarding the content of costly stabilizing additive or product regulatory requirements evolution.

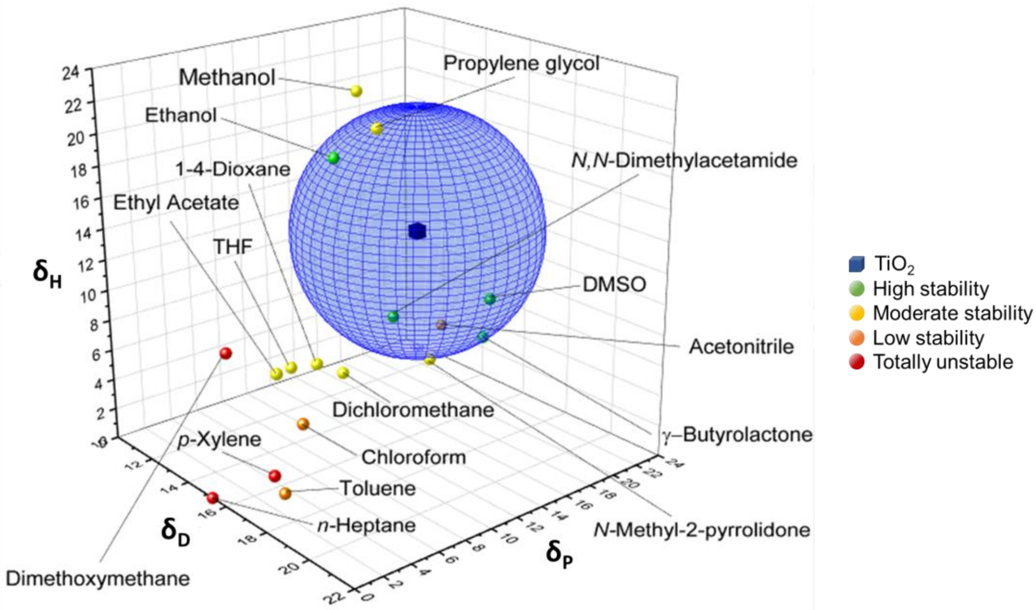

Figure 1 *: Hansen sphere obtained for TiO_2 particles (FIT=1, no solvent wrong in, no solvent wrong out)*

Definition

The semi-empirical Hansen's approach, which has been historically developed to predict the solubility of molecules, can be adapted to describe the particles stability in various solvents. This approach is based on the decomposition of the Hildebrand parameter δ, linked to the binding energy between two particles, into three different parameters δ_D, δ_P and δ_H describing respectively non-polar, polar and hydrogen interactions between the particle surface and the dispersion media as follow :

$$\delta = \sqrt{\delta_D^2 + \delta_P^2 + \delta_H^2}$$

Considering these non-polar, polar and hydrogen components, each particle or solvent can be represented by a point in a 3D-space with these components as coordinate values named HP coordinates. The stability of the particle under study is evaluated considering a range of solvents with known HPs exhibiting large variation in these 3D-space and followed by a ranking of the tested solvents as good or poor stabilization media. The border between good and poor solvents allows to build a sphere with a center corresponding to the HP coordinates of the particle as well as a radius R_0. If a solvent is situated inside the sphere of the particle, **it can be considered as a good stabilization media**.