

Turbiscan Stability Index (TSI)

- Stability evaluation with just one click-



The next step to Stability Comparison:

The Turbiscan® device is well-known for providing substantial information on the stability and dispersibility of any formulation. Such data is obtained by monitoring the evolution of the backscattered and/or transmitted light intensities over time. However, in some cases it may be difficult to objectively analyze the data without an expert eye, for example in case of simultaneous destabilization phenomena (e.g. sedimentation and aggregation). Formulation has developed a simple and robust criterium called the Turbiscan Stability Index (TSI) to rapidly compare and characterize stability of formulations. This application note describes how the TSI is calculated and provides with examples of use.

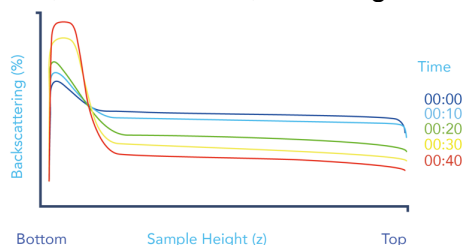
KEY BENEFITS

QUANTITATIVE
SIMPLE RANKING
FAST DECISION MAKING

Reminder of the Turbiscan principle

Turbiscan® technology is based on Static Multiple Light Scattering principle (S-MLS). An infrared light source (wavelength $\lambda=880$ nm) illuminates a sample and two sensors collect the Backscattered (BS) and Transmitted (T) signals. Both signals are directly linked to the particles' volume fraction and mean size. In addition, exploring these two signals (BS & T) allows to study a wider concentration range.

The BS and T signals are acquired repeatedly over time t at the whole sample height h (scanning from $z = 0$ to $z = h$ with a step of Δh). The resulting signal is time and spatial dependent: $T(t, z)$ and $BS(t, z)$. The composition of these scans allows to detect physical instabilities in the dispersion such as aggregation, sedimentation, creaming...



TSI definition

The comparison of the stability from formulation to formulation using only the raw T or BS signals can require advanced calculation. This is why the TSI has been introduced. It is of crucial importance to classify and compare the stability of many formulations quantitatively.

Using the TSI can be done with a simple method and just one number to describe global sample stability. The TSI is a number calculated *at time t* by summing-up all temporal and spatial variations in a considered zone:

$$TSI(t) = \frac{1}{N_h} \sum_{t_i=1}^{t_{max}} \sum_{z_i=z_{min}}^{z_{max}} |BST(t_i, z_i) - BST(t_{i-1}, z_i)|$$

with: t_{max} the measurement point corresponding to the time t at which the TSI is calculated, z_{min} and z_{max} the lower and upper selected height limits respectively, $N_h = (z_{max} - z_{min})/\Delta h$ the number of height positions in the selected zone of the scan and BST the considered signal (BS if $T < 0.2\%$, T otherwise).

Consequently, the sample is stable when the TSI tends toward zero and instable when the TSI is very high. Note that the TSI is equal to zero for $t=0$.

Case studies

1. Stability of nanoparticles for toxicological studies

In *in vitro* nanotoxicological studies, nanoparticles (NPs) must be dispersed in a cell culture medium before being administrated to cells. Classically, bio-compatible proteins such as BSA are added before dispersion to coat the TiO_2 NPs and thus enhance the stability in cell culture media.