The Cycle of Formulation Characterization from dispersibility and stability to redispersion

WHAT IS THE SCIENCE OF FORMULATING?

Formulating is the science of mixing different components to achieve desired properties or specifications. The ingredients are often not compatible, and they must be mixed following a specific strict procedure to obtain uniform and durable structure. This task is even more challenging when formulating with natural ingredients. The constant need to create new formulations or reformulate existing formulations requires thorough monitoring of formulation properties.

Formulation composition can be summarized as follows:

- **Liquid continuous phase**, water is the most commonly used solvent but not limited to.

- **Dispersed phase**: liquid, solid or air. The particularity of this phase is that it is non-compatible with the continuous phase. The particle/droplet size can vary from a few nm up to visible particles and the concentration ranges from ppm up to 95%. This is the phase that provides the desired end-user properties to nutrition…).

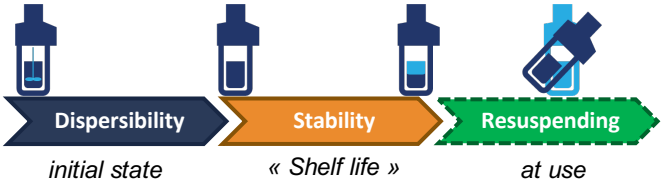
- **Stabilizers** are one of the key components of the formulation. They are essential to control the dispersion, achieve the desired particle size and maintain a "stable" formulation. Nowadays, the number of possibilities is very large and depends on the application. Surfactants have been and remain the most commonly used stabilizers. They either come from chemical synthesis or natural, renewable resources. Recent studies push towards using new polymers and biopolymers, proteins, and even other particles as stabilizers.

- **Additives** are added to adjust side properties, nevertheless essential for the user appreciation (viscosity, scent, color, texture…). These additives can have an affinity with either the continuous phase, the dispersed phase or the interface.

Formulations can contain over 50 different ingredients and the fine adjustment of the composition is the key to a high-quality formulation. During the development phase, it is of high importance to also consider the process, packaging and dispensing, storage conditions and usage conditions. The formula needs to be adapted for all these external parameters.

FORMULATION CHARACTERIZATION STEPS

Whether you are formulating paints, electronic slurries, cosmetics, food or pharmaceutical suspensions, there are 3 crucial steps, linked to the formulation lifetime, to be considered for a complete formulation characterization.



Dispersibility
Foundation stone of the formulation

Dispersibility is the ability to "suspend particles" (either solid, liquid or gas) in the continuous phase, in a way that allows them to be equally distributed in the whole volume and preserve their original size. It can be considered as the foundation stone of the formulation process and it is affected by:

- Solvent affinity with the particles
- Interactions between the continuous phase & stabilizer
- Interactions between the stabilizers & particles
- Stabilizer coverage of the interface
- Preparation process: mixing tool used, time and speed of mixing

A poor dispersibility will have a significant impact on final product specification as the particle/droplet size and homogeneity will affect overall stability, and so the durability in time of colors for inks, polishing efficiency for CMP slurries, taste for flavored food emulsions...