# Marcus Waxes for Water Based Emulsions

## Wax Emulsion Chemistry

***Marcus Polyethylene waxes have properties making them useful in modifying surface characteristics for a broad range of coatings and finishes. When water based systems are desired, the polyethylene wax must be incorporated in an aqueous medium. This is usually through a process called emulsification. Emulsion chemistry involves complex mechanisms that are influenced by chemical as well as equipment parameters.***

***Emulsions are usually categorized based on the surfactant system used. They are:***

***ANIONIC**: Typically incorporating a fatty acid salt such as an oleate*

***CATIONIC**: Typically incorporating imidazolline or ethoxylated fatty amines (stearyl or tallow).*

***NON-IONIC**: Most common emulsion type usually incorporating an ethoxylated nonyl phenol or fatty alcohol*

***The desired 'Quality' of an emulsion can vary between applications. In general a smaller emulsion particle size yields a more transparent and stable emulsion. In applications where good permeability and or transparency is a factor (e.g.. fiber finish and polish applications) a very small particle size emulsion may be desirable. In other applications (some textile applications) a larger particle size may work best. In all cases emulsion stability must be considered and settling or separation of the emulsion is to be avoided.***

## General Information for using oxidized Marcus waxes for emulsion preparation

Polyethylene homopolymers do not have functional groups which would allow for emulsification. Polyethylene wax is typically oxidized to an acid value in excess of 16 mg KOH/gm. Oxidation adds acid and ester functionality that allows for emulsification. Marcus oxidized polyethylene waxes suitable for emulsification include M3500 and M3400T.

Emulsification can take place under pressure or atmospherically. The most common methods of emulsification are:

***WAX TO WATER***: Polyethylene wax is melted with surfactant and non water ingredients and then combined with water under atmospheric pressure

***PRESSURE DIRECT***: Here all the ingredients are charged to the reactor at once and the reactor sealed to maintain pressure as the temperature is increased

***PRESSURE INDIRECT***: Similar to the direct method except dilution water is held back and added under pressure

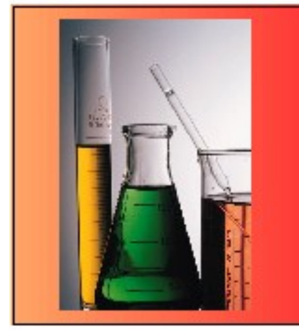
More detailed procedures are available for each of the above methods.

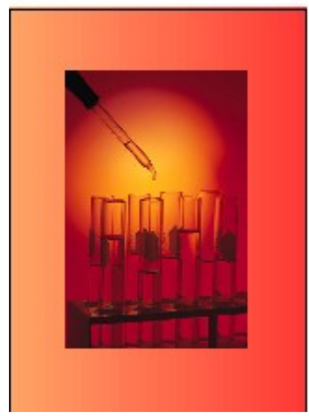
Equipment availability is usually a key factor in determining which emulsification process is used along with the melting point of the wax and volatility of other ingredients in the emulsion formulation.

A key step in formulating an emulsion is reaction of a base, typically KOH or an amine, with the functional groups on the oxidized polymer and/or fatty acid to render them soluble (saponification).

A check of the pH should be made to insure the acid and base have reacted.

A technique where the base is split, adding ~70% in the concentrate with the remainder in the dilution water has shown excellent emulsion formation when using the indirect dilution method.





The surfactant in the emulsion formulation forms micelles with the polyethylene wax entrapped inside. Caution should be taken as surfactants can vary from supplier to supplier. The optimal surfactant often depends on the application, compatibility and or cost considerations. In applications such as paper and textiles, for example, - it may be desirable to utilize a cationic system to attract the emulsion to anionic cellulose surface.

Stable polyethylene emulsions in the presence of $H^+$ can precipitate due to formation unemulsifiable RCOOH in the following reaction:

$$RCOOH + KOH <> RCOOH\text{-}K^+ + H_2O$$

It is recommended to evaluate emulsions in the lab prior to commercial production. A Parr reactor is a good lab unit for the preparation of small quantities of emulsions.

Marcus Oil & Chemical Pvt. Ltd.
Vill. Kasberia, H. P. L. Link Road,
Haldia-721602,
West Bengal, INDIA
Ph:091 3224 276541
Fax:091 3224 276696
Email contactus@marcusoil.com

Visit us at www.marcusoil.com