

Freezing Point Depressant Selection (FPD)

The addition of a freezing point depressant (FPD) is critical to the Ice Pigging process, enabling the ice slurry generated for Ice Pigging to have the desired rheological properties.

Nearly all substances that will dissolve in or mix with water will act as a FPD, but the performance of the ice will vary depending on the exact nature of the additive, its effect on the actual freezing point, its influence on the properties of the liquid phase of the slurry and the initial concentration. The specific effects are as follows:

- Bulk viscosity of ice slurry
- Flowability / lubricating effect of ice slurry (ability of ice to negotiate complex geometries)
- Final temperature of ice and efficiency of ice generation
- Prevention of the aging effects of ice slurry

A number of different FPDs are currently used for the Ice Pigging process in a range of different industries. Assessment of FPD suitability is typically based upon:

- Effectiveness as a freezing point depressant to form a consistent ice slurry
- Material compatibility (ice making equipment and process line material)
- Ease of mixing / procurement at desired concentration
- Health and safety considerations
- Commercial cost and security of supply
- Disposal (ease of / costs)
- Cleaning requirements of Ice Pigging equipment using FPD to form ice

Additives that have been used for the Ice Pigging process:

- Salt
- Citric acid
- Ammonium sulphate
- Sodium hydroxide
- Sodium sulphate
- Ammonia
- Dipropylene glycol
- Sugar
- Sorbitol
- Sodium nitrite
- Nitric acid

Note: other acids, salts and other soluble additives are available with the potential to be used as an FPD.

For additional reference refer academic paper *"CONCENTRATIVE PROPERTIES OF AQUEOUS SOLUTIONS:*

DENSITY, REFRACTIVE INDEX, FREEZING POINT DEPRESSION, AND VISCOSITY" that provides a list of 66 substances.