



## Cleaning sustainability

Depending upon the level of cleanliness required water based cleaning will be a multi stage process. Initial cleaning will always be made with “dirty” water with subsequent rinsing made with progressively cleaner liquid. Note that “tap water” may appear to be clean but, as far as critical surface cleaning is concerned, contaminants such as organic matter, mineral content and colloids are present which leave staining on the surface.

Accordingly the ultimate result will be based upon the quality of the final rinse which will invariably be made with de-mineralised water to a given required quality measured in microsiemens. This “pure” water must be monitored (usually measured by conductivity or resistivity) and maintained according to specification requirements.

*Cross contamination of wash and rinse waters cannot be completely eliminated and so aqueous processes produce significant amount of contaminated waste which must be disposed of correctly and compliantly. Of course clean water is environmentally friendly but waste stream contaminated with oils and particulates is not. Restrictions on waste disposal are increasingly severe.*

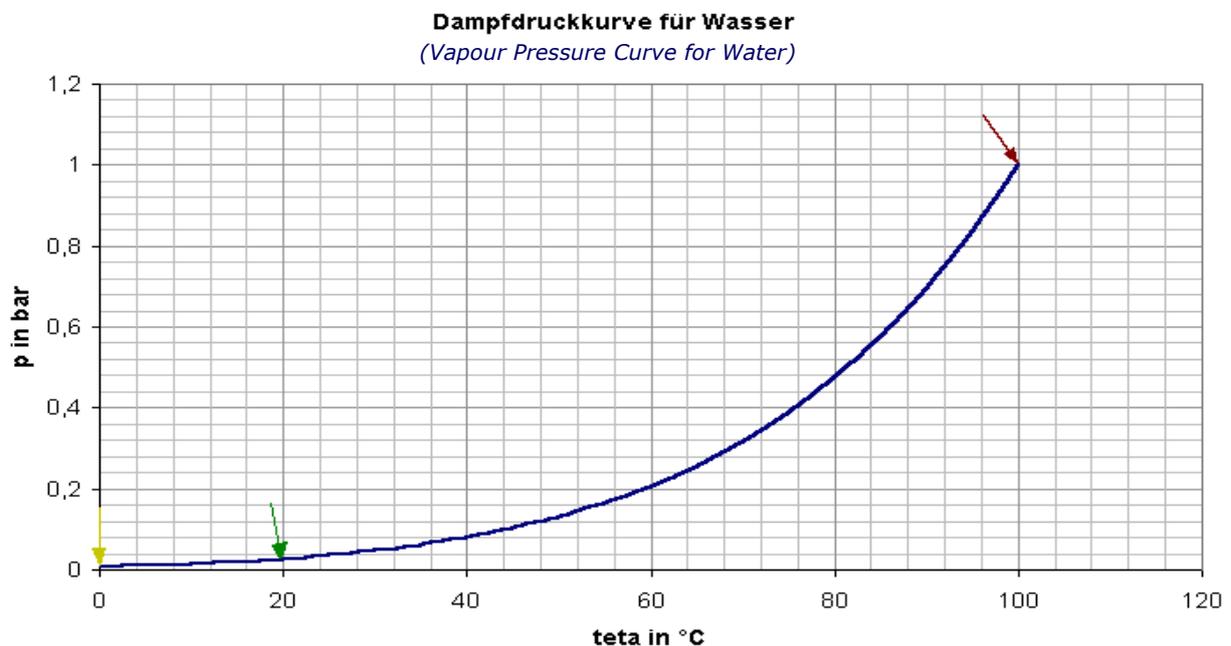
By contrast cleaning with solvent will include a final vapour phase rinse which is always perfectly clean solvent.

Water will require a chemical additive to increase solvency - this is very often an alkaline based product with surfactants. Note that this chemical will be consumed and concentration must be monitored and maintained.

Solvent based processes use standard distillation to continuously purify the liquid which maintains cleaning performance. By-pass distillation is also used to concentrate waste up to 95%. Whilst water based processes require constant monitoring (some sceptics claim that an on-site chemist is required for high integrity applications). The continuous distillation associated with solvent cleaning affords a very robust and reliable ongoing process.

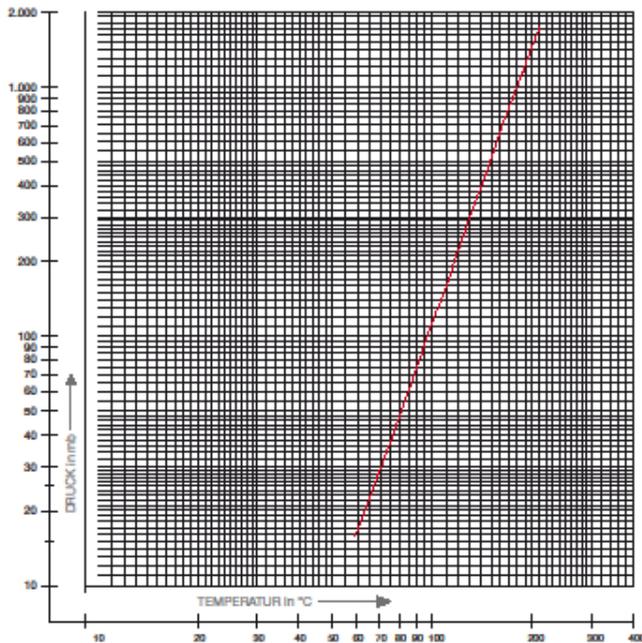
## Drying/vapour pressure

Water is none volatile and drying remains a critical issue especially with complex component geometries such as fine threads, blind holes and pipe/tube applications. Considerable energy is utilised in drying. Note that with organic solvents drying is quick and efficient.



## Dampfdruck von RG-Cleaner 63

(Vapour Pressure Curve for RG-Cleaner 63)



RG 63

80 °C	50 mbar
100 °C	100 mbar
117 °C	150 mbar
137 °C	300 mbar
157 °C	600 mbar
167 °C	800 mbar
173 °C	1.013 mbar

Compare these two graphs.

Note that the slope of the graph from the modified alcohol RG 63 is much higher from the beginning compared to the curve of water. This is due to the vapourising enthalpy of the liquids.

These two diagrams demonstrate the different boiling points of the liquids at a specific temperature. This means that water boils at 100 degrees under normal (ambient) pressure.

It is also shown that the vapour pressure of water is close to 0 below 40 degrees Celsius. This means that the boiling point is very low but the concentration in the vapour phase is also very low.

This can result in drying problems.

The saturation curve of a liquid is proportional to the steam pressure - The Ideal Gas Law.

The volatility of organic solvents ensures that thorough drying of metal component parts is both rapid and thorough. Compare the latent heat of evaporation of water at 2280kJ/kg with organic solvents at approximately 200 – 300kJ/kg. By applying a vacuum to the process chamber and therefore reducing the boiling point, residual component heat will ensure instant vapourisation allowing up to 10 cleaning cycles per hour.

## Cycle times

With multi step aqueous cleaning plus extended drying requirements cycle time is usually circa. 40 minutes for non complex components.

## Running costs

Water based processes will generally cost three times that of solvent cleaning. This largely due to the energy costs (drying), consumable costs (chemicals and pure water provision) and waste disposal.

## Environmental considerations

Note that aqueous processes require substantially more energy – this increases the operation's carbon footprint. The Climate Change Levy must also be considered.

## Health & Safety

It is important to understand that, whilst clean water is perfectly safe, most contaminants are not and the resulting waste stream may well be classed as hazardous.

Note that a solvent system offers a fully closed loop capability with both fresh solvent and waste stream management being managed by a secure delivery, storage and removal system without any operator contact.



*Note also that operators of water based processes must consider biological contamination by micro-organisms such as Legionella.*

*The modified alcohol Geiss RG 63 approved by Rolls-Royce Aerospace is classed as "Irritant" rather than the "Hazardous" labeling associated with traditional chlorinated solvents.*

*Note also that most aqueous chemicals/detergents will also be classed as "Irritant".*

Many believe that water based processes are somehow "greener" than solvent operations. In fact the reverse is absolutely true. It is also interesting to note that our consumables partner, Richard Geiss GmbH, is a solvent recycler. Used solvent is returned for processing and return to the market - truly an environmentally friendly package.

## The choice

Many applications can be met with either water or solvent based processes, Firbimatic Spa offers both technologies. Certainly the solvent route is absolutely proven in pipe and tube cleaning. With laboratory/test facilities for both processes we are able to offer initial trials to evaluate the feasibility of an aqueous process.

## About the author

*The author of this article, Glenn Greenlees, is the marketing director of Standard Industrial Cleaning Systems and Geiss UK, independent distributors "dedicated to offering the world's best in both aqueous and solvent cleaning technologies."*

*Glenn believes that with the many changes in environmental legislation, solvent classification together with a strong drive towards Health & Safety improvements it is vital that potential investors are given the facts regarding the technologies available along with the relevant legalities.*

*Standard Industrial Cleaning Systems is the UK importer and distributor for two of the world's most successful manufacturers Firbimatic Spa of Italy and Richard Geiss GmbH of Germany.*

