

## Chemicals used in metal technology, molecular groups, pH value

| Important chemicals used in metal technology |                          |   |   |  |
|--|--------------------------|---|---|--|
| Technical designation                        | Chemical designation     | Formula   | Properties  | Use  |
| Acetone                                      | Acetone (propanone)      | $(\text{CH}_3)_2\text{CO}$  | Colourless, combustible, lightly volatile liquid                        | Solvents for paints, acetylene and plastics                    |
| Acetylene                                    | Acetylene, Ethane        | $\text{C}_2\text{H}_2$  | Highly reactive, colourless gas, highly explosive                       | Fuel gas for welding, raw material for plastics                |
| Aqueous cleaner                              | Various surfactants      | $\text{--COO--}$<br>$\text{--OSO}_3\text{--}$<br>$\text{--SO}_3\text{--}$ | Various water-soluble substances  | Solvent, cleaning agent; emulsifying and thickening agent      |
| Carbon tetrachloride                         | Carbon tetrachloride     | $\text{CCl}_4$  | Colourless, non-combustible liquid, health-hazardous                    | Solvent for fats, oils and paints                              |
| Carbonic acid                                | Carbon dioxide           | $\text{CO}_2$   | Water soluble, non-combustible gas, solidifies at $-78^\circ\text{C}$   | Inert gas for metal active gas welding, dry ice as refrigerant |
| Cold cleaner                                 | Organic solvent          | $\text{C}_n\text{H}_{2n+2}$   | Colourless, sometimes highly combustible liquids                        | Solvent for fats and oils, cleaning agent                      |
| Copper vitriol                               | Copper sulphate          | $\text{CuSO}_4$   | Blue, water soluble crystal, moderately toxic                           | Electroplating baths, pest control, for scribing               |
| Corundum                                     | Aluminium oxide          | $\text{Al}_2\text{O}_3$   | Very hard, colourless crystals, melting point $2050^\circ\text{C}$      | Abrasive and polishing agent, oxide ceramic materials          |
| Ethyl alcohol                                | Ethyl alcohol, denatured | $\text{C}_2\text{H}_5\text{OH}$   | Colourless, highly combustible liquid, boiling point $78^\circ\text{C}$ | Solvent, cleaning agent, for heating purposes, fuel additive   |
| Hydrochloric acid                            | Hydrogen chloride        | $\text{HCl}$  | Colourless, pungent smelling, strong acid                               | Etching and pickling of metals, manufacture of chemicals       |
| Nitric acid                                  | Nitric acid              | $\text{HNO}_3$  | Very strong acid, dissolves metals (except precious metals)             | Etching and pickling of metals, manufacture of chemicals       |
| Soda   | Sodium carbonate         | $\text{Na}_2\text{CO}_3$  | Colourless crystals, slightly water soluble, basic effect               | Degreasing and cleaning baths, water softening                 |
| Spirits of ammonia                           | Ammonium hydroxide       | $\text{NH}_4\text{OH}$  | Colourless, pungent smelling liquid, weak lye                           | Cleaning agent (fat solvent), neutralisation of acids          |
| Sulphuric acid                               | Sulphuric acid           | $\text{H}_2\text{SO}_4$   | Colourless, oily, odourless liquid, strong acid                         | Pickling of metals, electroplating baths, accumulators         |
| Table salt                                   | Sodium chloride          | $\text{NaCl}$   | Colourless, crystalline salt, slightly water soluble                    | Condiment, for freezing mixtures, for chlorine extraction      |

MS

### Frequently occurring molecular groups

| Molecular group Designation | Formula           | Description   | Example           |                         |
|-----------------------------|-------------------|---|-------------------|-------------------------|
|                             |                   |   | Designation       | Formula                 |
| Carbide                     | $\equiv \text{C}$ | Carbon compounds; to some extent very hard  | Silicon carbide   | $\text{SiC}$            |
| Carbonate                   | $= \text{CO}_3$   | Compounds of carbonic acid, addition of heat yields $\text{CO}_2$   | Calcium carbonate | $\text{CaCO}_3$         |
| Chloride                    | $-\text{Cl}$      | Salts of the hydrochloric acids; usu. dissolve readily in water   | Sodium chloride   | $\text{NaCl}$           |
| Hydroxide                   | $-\text{OH}$      | Hydroxides are produced from metal oxides and water; behave as basics   | Calcium hydroxide | $\text{Ca(OH)}_2$       |
| Nitrate                     | $-\text{NO}_3$    | Salts of the nitric acids; usu. dissolve readily in water   | Potassium nitrate | $\text{KNO}_3$          |
| Nitride                     | $\equiv \text{N}$ | Nitrogen compounds; some of them are very hard  | Silicone nitride  | $\text{SiN}$            |
| Oxide                       | $= \text{O}$      | Oxygen compounds; most commonly occurring molecular group on earth, monoxide ( $\text{O}$ ), dioxide ( $\text{O}_2$ ) | Aluminium oxide   | $\text{Al}_2\text{O}_3$ |
| Sulphate                    | $= \text{SO}_4$   | Salts of the sulphuric acids; usu. dissolve readily in water  | Copper sulphate   | $\text{CuSO}_4$         |
| Sulphide                    | $= \text{S}$      | Sulphur compounds; important ores, chip breaker in free cutting steels  | Iron(II) sulphide | $\text{FeS}$            |

### pH value

| Type of aqueous solution            | ← increasingly acidic |           |           |           |           |           |           | neu-<br>tral | increasingly basic → |           |            |            |            |            |            |
|-------------------------------------|-----------------------|-----------|-----------|-----------|-----------|-----------|-----------|--------------|----------------------|-----------|------------|------------|------------|------------|------------|
| pH value                            | 0                     | 1         | 2         | 3         | 4         | 5         | 6         | 7            | 8                    | 9         | 10         | 11         | 12         | 13         | 14         |
| Concentration $\text{H}^+$ in mol/l | $10^0$                | $10^{-1}$ | $10^{-2}$ | $10^{-3}$ | $10^{-4}$ | $10^{-5}$ | $10^{-6}$ | $10^{-7}$    | $10^{-8}$            | $10^{-9}$ | $10^{-10}$ | $10^{-11}$ | $10^{-12}$ | $10^{-13}$ | $10^{-14}$ |