- Contains hydrogen ions (H+) when dissolved in water and has a pH less than 7
- Turns blue litmus paper to a red colour

BASES

Bases are substances that cancel the effect of an acid. More appropriately, a base is defined as a substance that neutralizes the effect of an acid to form a salt and water. Bases are usually metal oxides or metal hydroxides.

Examples of Bases and Alkalis (daily life)

- Sodium hydroxide (NaOH) or caustic soda
- Calcium hydroxide ($Ca(OH)_2$) or limewater
- Ammonium hydroxide (NH_4OH) or ammonia water
- Magnesium hydroxide ($Mg(OH)_2$) or milk of magnesia
- Many bleaches, soaps, toothpastes and cleaning agents have base

Alkalis: Alkalis are bases that are soluble in water. Examples of alkalis are sodium hydroxide NaOH, Potassium hydroxide KOH, Calcium hydroxide $Ca(OH)_2$ and Ammonia NH_3. Alkalis release hydroxide ions (OH^-) in solution. On this note then, when acid (which release H^+ or H_3O^+) and alkalis are mixed, the following reaction takes place.

$$H^+ + OH^- = H_2O$$

OR

$$H_3O^+ + OH^- = 2H_2O$$

Strong and Weak Alkalis

Strong alkalis are those that ionize completely in water to release many hydroxide ions into solution. E.g. NaOH and KOH.

Ammonia and calcium hydroxide are said to be weak acids because they ionize to form only few hydroxide ions in solution.

$$NH_3(aq) + H_2O = NH^+_4(aq) + OH^- (aq)$$

Properties of Bases and Alkalis

- Corrosive ('burns' your skin), Soapy feel, Has a pH more than 7, Turns red litmus paper to a blue colour,Many alkalis (soluble bases) contain hydroxyl ions (OH^-), Reacts with acids to form salt and water.

pH Measurement

pH is a measure of the acidity or alkalinity of a substance. pH is measured using the pH meter. The pH scale ranges from 0 to 14 and it is a convenient

Organic Coatings

The coatings covered are limited to organic paint materials, with the exception of inorganic zinc coatings which are included, because they are most commonly used in conjunction with organic coatings and are applied by spray, like organic coatings. Powder coatings are also described, although their application is somewhat different from typical brush, roller, or spray application.

METHODS BY WHICH COATINGS PROTECT METALS FROM CORROSION

Coatings have three basic mechanisms for protecting metals from corrosion, although more than one of these mechanisms may be used by a coating.

These mechanisms are:

* Cathodic protection
* Corrosion inhibitors.

Barrier Protection

Most coatings provide corrosion protection by forming a barrier relatively impermeable to moisture and electrolytes necessary for corrosion. Obviously, for optimum protection, the barrier should be as impermeable, thick, and continuous as practical.

Cathodic Protection of Steel

Some protective coatings have a high loading of fine zinc particles, so the particles in the cured film are in electrical contact with each other and with the underlying steel. This permits a type of cathodic protection. Presently, two basic types of zinc-rich coatings are used on steel: organic and inorganic products.

Inhibitive Pigments

Some pigments are added to primers to inhibit corrosion at the coating/metal interface. Red lead is the most common example of an inhibitive pigment.

COMPOSITIONS AND PROPERTIES OF COATINGS

Components of Coatings and Their Functions

All ingredients used to formulate a coating can be placed in one of three

$$\text{Or} = \text{Wt. of substance producing hardness} \times \frac{\text{Eq. wt. of } CaCO_3(50)}{\text{Eq. wt. of substance}}$$

Problem: What are the parameters for checking water quality for domestic use.

Ans. The parameters for checking water quality for domestic use follows as:

(i) Water should not contain hardness (not more than 300 ppm)

(ii) Turbidity should not be more than 10 ppm.

(iii) pH of domestic water should be around 7.5 – 8.0.

(iv) Coloured impurities should not be more than 20 ppm.

(v) It should not contain dissolved solids more than 500 ppm any how, desirable is less than 100 ppm.

Problem: Given atomic weights of elements as H = 1, C = 12, N = 14, O = 16, Na = 23, Mg = 24, Al = 27, S = 32, Cl = 35.5, Ca = 40, Fe = 56. Find multiplication factor for converting into equivalents of $CaCO_3$.

For $Ca(HCO_3)_2$, $Mg(HCO_3)_2$, $CaSO_4$, $CaCl_2$, $MgSO_4$, $MgCl_2$, $MgCO_3$, CO_2, $Mg(NO_3)_2$, HCO^-_3, OH^-, $NaAlO_2$, $Al_2(SO_4)_3$ and $FeSO_4 . 7H_2O$

Table 7.1

Constituent salt/ion	Molar Mass	n-factor	Chemical equivalent Molar mass = n-factor	Multiplication factor for converting into equivalent of $CaCO_3$
$Ca(HCO_3)_2$,	162	2	162/2 = 81	100/(2 × 81) = 100/162
$Mg(HCO_3)_2$,	146	2	146/2 = 73	100/(2 × 73) = 100/146
$CaSO_4$,	136	2	136/2 = 68	100/(2 × 68) = 100/136
$CaCl_2$,	120	2	120/2 = 60	100/(2 × 60) = 100/120
$MgSO_4$,	111	2	111/2 = 55.5	100/(2 × 55.5) = 100/111
$MgCl_2$,	95	2	95/2 = 417.5	100/(2 × 47.5) = 95100/
$MgCO_3$,	84	2	84/2 = 42	100/(2 × 4842) = 100/
CO_2,	44	2	44/2 = 22	100/(2 × 2244) = 100/
$Mg(NO_3)_2$,	148	2	148/2 = 74	100/(2 × 74)148 = 100/
HCO^-_3,	61	1	61/1 = 61	100/(2 × 61) = 122100/
OH^-,	17	1	17/1 = 17	100/(2 × 17) = 13400/
CO_3^{-2},	60	2	60/2 = 30	100/(2 × 30) = 10600/
$NaAlO_2$,	82	1	82/1 = 82	100/(2 × 82) = 100164/
$Al_2(SO_4)_3$,	342	6	342/6 = 57	100/(2 × 57) = 100/114
$FeSO_4$, $7H_2O$,	278	2	278/2 = 139	100/(2 × 139) = 100/278

- **Sequestering agents**: such as inorganic phosphates, which act as inhibitors and implement a threshold effect.
- **Oxygen scavengers**: sodium sulphite, tannis, hydrazine, hydroquinone/ progallol-based derivatives, hydroxylamine derivatives, hydroxylamine derivatives, ascorbic acid derivatives, etc. These scavengers, catalyzed or not, reduce the oxides and dissolved oxygen. Most also passivate metal surfaces. The choice of product and the dose required will depend on whether a deaerating heater is used.
- **Anti-foaming or anti-priming agents**: mixture of surface-active agents that modify the surface tension of a liquid, remove foam and prevent the carry over of fine water particles in the steam.
- **Softening** chemicals used include soda ash, caustic and various types of sodium phosphates, calgon(SHMP). These chemicals react with calcium and magnesium compounds in the feed water to separate Softening chemicals may be added continuously or intermittently depending on feed-water hardiness and other factors. Chemicals added to react with dissolved oxygen (sulphate, hydrazine, etc.) and chemicals used to prevent scale and corrosion in the feed-water system (polyphosphates, organics, etc.) should be fed in the feed-water system as continuously as possible.
- Internal treatment involves addition of chemical to the boiler water either to precipitate the scale forming impurities in the form of sludges, which can be easily removed or convert the impurities to soluble compounds, so that scale formation can be avoided. Important internal treatments involve.
- *Colloidal Conditioning:* Organic substances like kerosene, tannin, agar-agar are addedto form gels and form loose non-sticky deposits with scale-forming precipitates, whichcan be easily removed by blow-down operations in low pressure boilers.Different sodium phosphates like NaH_2PO_4, $Na_2HPO_4$and Na_3PO_4
- are added to high pressure boilers to react with the hardness forming impurities to form soft sludge of calcium and magnesium phosphates and finally this can be removed by blow down operation.
- $3CaCl_2 + 2Na_3PO_4 \rightarrow Ca_3(PO4)_2 + 6NaCl$
- *Carbonate conditioning:*
- Sodium carbonate is added to the water of low pressure boiler whereby the scale forming $CaSO_4$ gets converted to loose sludge of $CaCO_3$,which can be easily removed by blow-down operation.
- $CaSO_4 + Na_2CO_3 = CaCO_3 + Na_2SO_4$