Neutralizing Amine and Phosphate Specification

The Objective of this document is to describe the process situation and stipulate the Amine and Phosphate Specification which will be utilized and field tested in MEKPCO Site.

Since Phosphate program and Neutralizing Amine are interrelated with each other, the test run for both of them will be carried out simultaneously.

**Process and dosing Package Conditions**

The Amine and Phosphate are utilized for a BFW System with 400 Ton/hr when the capacity of the unit is 100 %. However, thanks to some factors, the Field trial will be performed with a BFW amount of 200-250 Ton/hr. Such amount of BFW is used as make-up for Main Steam Drum which operates at 80-90 barg and 280-300 C. In addition, there is Secondary Steam Drum which operates at 29-35 barg and 200 C.

The capacity of Amine dosing Tank and Dosing Pump are 3400 Liter and 40 L/h respectively. Amine Dosing Pump discharge is routed to Deaerator and the suction of BFW Pumps.

The capacity of Phosphate dosing Tank and Dosing Pump-7051 and Dosing Pump-7052 are 1000 Liter, 4 L/h and 3 L/h respectively. P-7051 discharge is routed to BFW Line located near to Main Steam Drum and P-7052 discharge is pathed to BFW Line located near to Secondary Steam Drum.

**Chemicals Specification**

1. **Phosphate**

Since DMW is used for the creation of BFW, the hardness is approximately Trace at all times. Because of aforementioned sentence and Steam Drums conditions, **Chelant and All-Polymer Programs** are **rolled out** and not allowed to be utilized in MEKCO site.

Only Phosphate Residual Program and Coordinated Phosphate Program are preferred to be used. However, Phosphate-Polymer Program will be allowed if a stable polymer is incorporated in Formulation of Blended Liquid Phosphate.

The chemical Provider should inform the MEKPCO Process Department of the characteristics of the Polymer used, including:

1. The Polymer Structure and its molecular weight profile
2. Stability under boiler operating conditions
3. Dispersant Capacity
4. Breakdown Mechanism, Products, and Temperature.

If chemical provider takes the Phosphate Residual Program, chemicals from Polyphosphates are recommended. Note that organic phosphate such as HEDP is not allowed to be incorporated in the formulation since such product is not designed for boilers operating at 80barg.

If chemical provider takes the Coordinated Phosphate Program, the following should be noticed:

1. Na/PO4-3 molar ratio is preferred to be maintained at 2.5-3.
2. The manufacturer should provide the MEKPCO Process Engineering Department with the calculation sheet, proving that their product Na/PO4-3 molar ratio is between 2.5-3.
3. The manufacturer is required to produce a blended phosphate by weight percentage 6% and later in MEKPCO site, it will be diluted to 2-3% in mixing TK.
4. The calculated Phosphate needed for one month is approximately 2.4 Ton if wight percentage is 6 percent and orthophosphate residual is about 10 ppm.

The calculation sheet is attached at the end of this document.

1. **Neutralizing Amine**

Neutralizing Amine which will be utilized in MEKPCO are Two-Component or Three-component blended Amine. Three-component blended Amine is preferred. Neutralising Amines are designed based on three characteristics:

1. Basicity
2. Neutralising Capacity.
3. Distribution Ratio

For high Basicity and Distribution Ratio, Following Amines are recommended:

1. Cyclohexylamine
2. Methoxypropylamine
3. Diethylaminoethanol

For Neutralizing Capacity, following Amines are recommended:

1. Monoethanolamine
2. Morpholine
3. Methoxypropylamine

For low Distribution Ratio to protect the BFW line, the following are recommended:

1. Diethanolamine
2. Morpholine
3. Monoethanolamine
4. Methoxypropylamine

**Operating Parameter Range**

The following Table represents the operating parameter for Water:

In Green Color.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Drum-Type Boilers Using High-Purity (Deionized) Feedwater\*** | | | | | | |
| **Boiler Water Component, mg/L** | **Drum Pressure, psig (MPag)** | | | | | |
| **< 600 (4.1)** | **601–750**  **(4.1–5.2)** | **751–900**  **(5.2–6.2)** | **901–1000**  **(6.2–6.9)** | **1001–1500**  **(6.9–10.3)** | **1501–2000**  **(10.3–13.8)** |
| TDS (max)† | Use same limits as for soft feedwaters | 970 | 750 | 600 | 50 | 50 |
| Phosphate (as PO4) | 20–40 | 15–25 | 15–25 | 5–10 | 5–10 |
| pH | 9.8–10.2 | 9.8–10.2 | 9.4–9.7 | 9-9.5 | 9–9.5 |
| Silica (as SiO2) max‡ | 30 | 20 | 8 | 2 | 1 |
| DEHA |  |  |  | 150-250 |  |
|  | | | | | | |

**Evaluation Criteria**

The following Table describes the points dedicated to each parameter.

|  |  |
| --- | --- |
| Dosage in month | 50% |
| PH in Range | 6% |
| Phosphate Residual | 6% |
| Turbine Condensate Conductivity | 6% |
| Water Conductivity | 6% |
| Silica Content | 6% |
| Technical and Educational Services | 20% |
| Plotted Diagram | Not Clear |

If applicable, a diagram like below will be plotted to monitor the relationship between phosphate Residual, PH and Na/PO4-3 molar ratio.

Note: The Points given to different parameter might deviate by or another parameter might be added during actual situation.

Calculation Sheet

Blow-Down Flow Rate = 20 m3 / hr

Phosphate Residual = 10 ppm

Phosphate Make-up Flow Rate =

Supposedly each Gallon contains 200 kg of 6% Phosphate, then:

Active in each Gallon =

Required Phosphate Dosage = 144/12 = 12 Gallons / month

Required Weight =

Note that if the Required Phosphate Residual is 5 ppm, then:

The required Dosage would be 1200 Kg

Steam Flow Rate = 200 m3/hr.

Mg/l of different Amines needed to maintain the PH between 9-9.5 is approximately 4-5 mg/l, then the amount of Amines needed for one month would be:

Amines Make-up Flow Rate = Active

Supposedly each Gallon contains 200 kg of 40 % Amine, then:

Active in each Gallon =

Required Amines Dosage = 576 / 80 = 7 Gallons / month

Required Weight:

It is a theoretical calculation, but in practice, less amount of Amine is needed. As a guideline, it is about 1 Ton per month.

Note that 40% of Amine is a common concentration and the providers may increase the concentration at their will.

References:

1. Nalco Water Handbook
2. Association Water Technology
3. Kurita (Japanese Water Standards)