

BHEL SPECIFICATION FOR MANUFACTURE AND TESTING OF CORROSION INHIBITORS BHEL MAX & BHEL SOL

BHEL MAX & BHEL SOL inhibitors are required to be prepared by mixing of chemicals of specified quality and in a prescribed order.

List of raw chemicals and approximate quantity required for making the inhibitor formulations is given in annexure – I, as guidance.

Procedure for the preparation of the inhibitors is given in annexure – II

The inhibitors prepared as above shall not give metal loss more than 1.0 gram/Sq. m / hour when tested as per test procedure given in annexure – III

General conditions for the preparation and supply of the inhibitors are given in annexure – IV.

**LIST OF RAW CHEMICALS, SPECIFICATIONS REQUIRED FOR
MANUFACTURE OF BHESSOL AND BHEL MAX.**

S.No.	Details of Chemicals
01	Formaldehyde (As per BIS:3321 – 1973) Aldehyde content (as HCHO) % by weight : 37.0 (Min) Acidity (as HCOOH) % by weight : 0.05
02	Formic acid (As per BIS : 9908 – 1981) Grade 2. Total acidity (as HCOOH) % by weight : 85% (min) Acids other than formic acid (% byweight) : 1.0 (Max)
03	Cyclohexylamine(As per BIS : 12085 – 1987) Purity : 99.2% (Min) Relative density at 25C : 0.860 to 0.870
04	Dicyclohexylamine Purity : 99.0% (Min) Relative density at 20C : 0.912 to 0.913
05	Diethyleneglycol (As per BIS : 7918 – 2001) Purity : 98.5% (Min) Relative density at 25 C : 1.114 – 1.117
06	Vulkacit Mercapto (oil free) (2 – mercapto benzothiazole) (oil free) Density : 1.5g/cm ³ Purity : 95% (Min) Ash : 0.50% (Max)
07	Diethanolamine (As per BIS : 7911 – 2000) Purity ; 98.0% (min) Relative density at 20 C: 1.015 to 1.020

* Quantity includes for wastages, spillages, evaporation loss etc. during handling and preparation of the inhibitor formulation.

PROCEDURE FOR THE PREPARATION OF CORROSION INHIBITORS BHEL MAX & BHEL SOL

The following is the description of the method for the preparation of the above two inhibitors.

1.0 BHELMAX

Ingredients and Quantity for a 74 kg batch:

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|---|------------|
| a) Vulkacit Mercapto (2 – Mercapto benzothiazole) | ... 24 kgs |
| b) Diethanolamine | ... 50 kgs |

Process:

The above two (a) and (b) are to be mechanically mixed in a HDPE vessel to a homogeneous liquid preferably using a mechanical stirrer.

2.0 BHELSOL

Ingredients and Quantity for a 60 litres batch:

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|----------------------|-----|------|
| 1. Diethyleneglycol | ... | 30 L |
| 2. Dicyclohexylamine | ... | 10 L |
| 3. Cyclohexylamine | ... | 5 L |
| 4. Formaldehyde | ... | 5 L |
| 5. Formic acid | ... | 10 L |

Process:

The above ingredients are to be mixed in the same order as given above, in HDPE vessel taking care that the temperature of the mix does not exceed 50°C. This could be achieved by using a water cooled reactor vessel / Mixing the ingredients by adding in small quantities at a time and stirring the contents periodically and allowing it cool down when the temperature rises above 50°C. If necessary, external cooling shall be adopted to contain the temperature.

**PROCEDURE FOR EVALUATION OF BHELMAX AND BHELSOL FOR THEIR
EFFECTIVENESS TOWARDS INHIBITIVE ACTION**

The following procedure will be adopted for evaluation of inhibitor blends.

Procedure

Specially prepared corrosion coupon will be weighed in an analytical balance and will be immersed in the solution containing the following chemicals in a pressurized reactor.:

Ammoniated EDTA solution with 4% EDTA (wt by wt) concentration and pH 9.0 to 9.5

BHELMAX 0.15% (wt by wt)

BHELSOL 0.15% (vol by vol)

The temperature of the reactor vessel will be increased to 140 deg C and maintained for 4 hours between 135 to 140 deg C. then the reactor vessel will be cooled to 90 deg C .. The coupon will be retrieved , washed with DM water . and weighed after drying. The metal loss will be calculated.

3.0 Criteria of Quality

Metal loss in g / sq.m / h should not exceed 1.0 for acceptance.

**GENERAL CONDITIONS FOR THE PREPATATION & SUPPLY OF
BHELMAX & BHELSOL INHIBITOR**

A. PREPARATION OF THE INHIBITORS:

1. BHELMAX & BHELSOL are proprietary formulation of BHEL and are covered under India Patents act.

The preparation and supply of there two inhibitors shall be made only against BHEL purchase order.

Misuse of the same is a patent violations

2. Any variation from the specifications of the raw chemicals given may result in process upsets, deterioration in the quality of the finished formulation
3. All the specified chemicals shall the procured from reputed suppliers to ensure the quality of final product .
4. The process furnished for BHEL SOL will produce copious fumes. It is recommended to conduct this process and as well preparation of BHELMAX under fume extraction facility as per pollution control requirements.
5. The processes mentioned for BHELMAX & BHELSOL are to the conducted under supervisor of a qualified professional chemist/Chemical Engineer.
6. BHEL shall not hold any responsibility for any misuse of raw materials and finished products under any clause.
7. BHEL is not responsible for vendor's technical, commercial, safety and legal issues assuring out of non- adherence to these recommendations.
8. Vendors shall be responsible for disposing the effluent / wastages if any as per statutory norms.
9. The storage of the raw chemicals are to be done in a well ventilated premises licensed for the storage of organic chemicals.
10. Initially a small sample of chemicals can be mixed at vendor's works and shall be tested at BHEL's R&D lab, Trichy.After establishing the inhibitor efficiency , bulk batch of mixing can be done on clearance from BHEL PSSR
- 11 **Preparation of sample and bulk batch are to be done under the direct supervision of BHEL.**

B. SUPPLY OF INHIBITORS :

1. The items are required to be supplied in 30 litre new carboys (HDPE) provided with inner lid and cap as given under, in sealed condition.
 - a) BHEL MAX in Wide mouthed Carboy Black in color
 - b) BHEL SOL in Narrow mouth carboy Blue in color
2. The material shall be supplied in One Lot to BHEL site as indicated in the Purchase Order
3. The BHEL MAX & BHEL SOL inhibitors will be inspected by BEHL / PSSR, before dispatch.
4. The items shall be dispatched to site only after clearance given by PSSR.
5. Material Safety Data Sheet (MSDS) shall be furnished by the vendor along with supply of inhibitors.