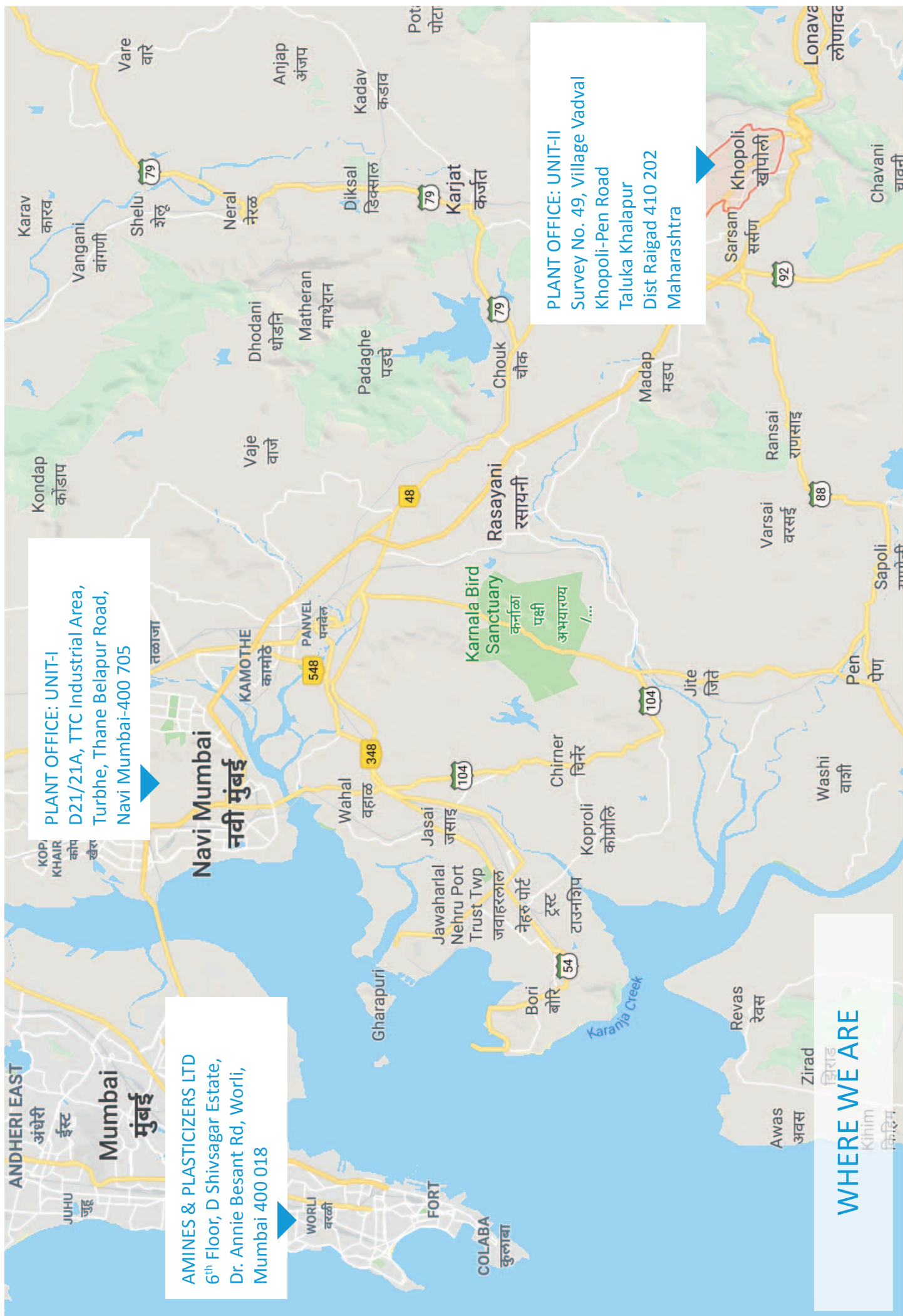


THE WORLD OF AMINES AND SPECIALTY CHEMICALS



AMINE SOLVENT PURIFICATION WITH
FILTRATION – ION EXCHANGE – ELECTRODIALYSIS



AMINES & PLASTICIZERS LTD
6th Floor, D Shivsagar Estate,
Dr. Annie Besant Rd, Worli,
Mumbai 400 018

PLANT OFFICE: UNIT-I
D21/21A, TTC Industrial Area,
Turbhe, Thane Belapur Road,
Navi Mumbai-400 705

PLANT OFFICE: UNIT-II
Survey No. 49, Village Vadval
Khopoli-Pen Road
Taluka Khalapur
Dist Raigad 410 202
Maharashtra

WHERE WE ARE

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AMINOSOL® is a registered trademark of Amines & Plasticizers Ltd., India

ZEOCHEM™ is a registered trademark of ZEOCHEM



APL GROUP OF COMPANIES

1973

AMINES & PLASTICIZERS LIMITED

1984

APL INDUSTRIAL GASES

1995

MORPHOLINE, MORPHOLINE DERIVATIVES &
TEXTILE UXILIARY CHEMICALS

2000

GAS TREATING CHEMICALS & SERVICES

2001

APL INFOTECH LIMITED

2005

PHARMACEUTICAL INTERMEDIATES

2007

APL REALTORS PVT. LTD.

2008

APL ENGINEERING SERVICES PVT. LTD.

2010

COMMISSIONING OF ETHOXYLATION UNIT
FOR EO/PO PRODUCTS

2014

OIL FIELD CHEMICALS

2016

AMINES & PLASTICIZERS FZE, UAE

2018

AMINE PURIFICATION SERVICES



AMINES & PLASTICIZERS PROFILE

Amines & Plasticizers Ltd. (APL) was incorporated in 1973 as a PLC, registered under the Indian Company Act of 1956, having its Corporate Office in Mumbai, India. The manufacturing facility is in Navi Mumbai. We take pride in ourselves as one of the leaders in the production of Ethanol Amines, Alkyl Alkanolamines, Gas Treating Solvents and Amine Purification Services in India. Over the years, APL has forayed into a wide range of industries. Our Products and Services include: Information Technology, Engineering & Fabrication, Oil Field Chemicals, Industrial Gases, Realty and Amine Purification Services. It is our constant endeavour to provide Quality Products and Services of Global High Standards and Value for Money.

APL is key player in producing various Specialty Ethoxylates and Propoxylates, Block Polymers and Co-Polymers of EO and PO besides Fatty Alcohol EO+PO derivatives, PPG's (of various molecular weights like 425, 900, 1020, 2000 & 4000), Cement grinding aids - TIPA 85% & DEIPA 85%, Phenoxyethanol of High Purity and **Oil field chemicals** such as H₂S scavengers, Demulsifiers, Acid Corrosion inhibitors, Flow improvers/Pour point Depressants for Crude oil as well as Lube oil, Bactericides, Emulsifiers & Mud Surfactants, Dispersants for Oil spills etc.

The Ethanolamines Plant was set up in **Technical Collaboration** with the erstwhile **Napthachemie**, France (now a part of **British Petroleum**) and Plant Engineering was done by Ralph M. Parsons, USA. For all other products the Company has developed the technologies based on its own in house R&D. **APL** is an **ISO-9001:2015, ISO-14001-2015 & OHSAS-18001-2007** Certified Company and is a global supplier of organic chemicals used in Oil Refineries, Natural Gas Plants, Ammonia Plants, Petrochemical Plants, Pharmaceuticals, Agrochemicals, Textiles & Cosmetics etc., meeting customers demands to their utmost satisfaction in keeping with APL's Quality Policy.

In the field of ethanolamines and Alkyl Alkanolamines **APL** is serving approximately 75-80% of the total demand of the Indian Market and is regularly exporting material to over 50 countries globally including USA, Canada, Germany, New Zealand, Korea, Japan, Australia, and the Middle East countries.

APL pioneered the manufacture of the Methyl Diethanolamine (MDEA) in India, an Ethylene Oxide derivative and is constantly striving to develop new products through its R&D efforts so as to expand its current product range to meet customer and market requirements.

APL has also pioneered the manufacture of Morpholines & Alkyl Morpholine in India. It is the world's third largest producer of N-Methyl Morpholine Oxide, which is the preferred solvent used for the manufacture of Viscose Staple Fibre by the Solvent Spun Process. APL's range of Alkyl Morpholines includes Acetyl, Formyl, Methyl, Ethyl, Hydroxy Ethyl Morpholines etc.

APL provides amine hygiene and amine solvent management to amine end users with two well established technologies, the ION EXCHANGE and the ELECTRODIALYSIS, both on skid mounted units.

APL is the only amine vendor world wide offering both technologies to purify amines on-site and on-line.

APL is a distributor of ZEOCHEM™, Zeochem AG Europe and Zeochem LLC USA for their Molecular Sieves and Activated Alumina.

APL'S PRODUCT RANGE - CHEMICALS

Alkyl Alkanol Amines	
Methyl Monoethanolamine*	(MMEA)
Methyl Diethanolamine	(MDEA)
Di- Methyl Ethanolamine*	(DMEA)
Di- Ethyl Ethanolamine*	(DEEA)
Ethyl Monoethanolamine*	(EMEA)
Ethyl Diethanolamine	(EDEA)
Mono-n-propyl Monoethanolamine	(PMEA)
Mono-n-propyl Diethanolamine	(PDEA)
Mono-n-Butyl Ethanolamine	(BMEA)
Mono-n-Butyl Diethanolamine*	(BDEA)
Di-Butyl Ethanolamine	(DBEA)
Poly Ethanolamine	(PEA)
Tertiary Butyl Monoethanolamine	(TBMEA)
Tertiary Butyl Diethanolamine	(TBDEA)

Alkanolamines	
Triisopropanolamine-85 %	(TIPA 85%)
Monoethanolamine *	(MEA)
Diethanolamine	(DEA)
Triethanolamine-Tech	(TEA-85%min)
Triethanolamine-pure*	(TEA-99%)
Diethanolamine LFG	(DEA-85%)

* Used also in Pharmaceuticals Applications

APL'S PRODUCT RANGE - CHEMICALS

Morpholine & Substituted Morpholines

Morpholine*	
N-Methyl Morpholine *	(NMM)
N-Methyl Morpholine Oxide 50%*	(NMMO)
N-Ethyl Morpholine*	(NEM)
N-Formyl Morpholine	(NFM)
Hydroxy Ethyl Morpholine*	(HEM)
(2 Morpholino Ethanol)	
N-Acetyl Morpholine	(NAM)
N-Butyl Morpholine	(NBM)

Specialty E.O. / P.O. Products

2-Phenoxy Ethanol*
1-Piperidine Ethanol (2-Piperidino Ethanol)*
Diethanol Isopropanolamine 85% (DEIPA 85%)
N-2 Hydroxy Ethyl Pyrrolidine*
N-Benzyl Ethanolamine* (NBzEA)

E.O. / P.O. Derivatives

Polypropylene glycol 200/400/600/800*
Polyethylene glycol 425/900/2020/4000*
APOL-61/62/64/68
Amine Polyols
Glycerol Polyol
Polyethylene glycol Adipates
Sorbitol mixture Ethoxylates.
Alcohol Ethoxylates*

* Used also in Pharmaceuticals Applications

APL'S OIL FIELD PRODUCTION CHEMICALS

Sr. No.	Application	Recommended product	Discription	Advantages
1.	H2S Scavenger	AMINOSOL HST IP AMINOSOL HST M80	Triazine IPA based Triazine MEA based	H2S scavenger for crude oil H2S scavenger for drilling fluids
2.	Demulsifier	AMINO DE 001 AMINO DE 002	Resin Alkoxylate based Resin Alkoxylate based Formulated Cyclie amine blend	These are oil soluble additives, which brake the emulsion of water in Oil / crude oil
3.	Acid Corrosion inhibitor	AMINO ACI 001 AMINO ACI 002 AMINO ACI 003	Formulated Imidazoline based Formulated Imidazoline based	These additives Protect metal surface from Acid corrosion by forming a film on the surface Packer fluid CI
4.	Flow Improver/ Pour Point depres- sant/ Paraffin Inhibitor	AMINO PPD C 001 AMINO PPD C 002 AMINO PPD C 003 AMINO PPD C 004	Polyacrylate based Polyacrylate based Polyacrylate EVA copolymer Polyacrylate EVA copolymer	These polymer based additives reduce the pour point of high waxy Crude oil & improves the flow properties.
5.	Flow Improver / Pour Point depres- sant	AMINO PPD L 101 AMINO PPD L 102	Polymethacrylate based Polymethacrylate based	These Lube oil PPD's are based on modified poly-methacrylate which improves the flow of Lube oils at lower temp.
6.	Bactericides	AMINOCIDE BK 50 AMINOCIDE BK 80	Benzalkonium chloride based Benzalkonium chloride based	These are quaternary ammonium chloride salts having high flash point
7.	Emulsifiers	AMINOL X 100 AMINOL OC 180	Alkyl aryl ethoxylate Fatty alcohol ethoxylate	Multifunctional emulsifier Multifunctional emulsifier
8.	Anti Forming Agent	PPG 4000	Propylene Oxide Polymer	Solubilizing agent

OTHER SPECIALTY CHEMICALS

Sr. No.	Application	Recommended product	Discription	Advantages
1.	Construction Chemical	CEMAID SS M 50	Polycarboxylate based Super Plasticizer	Reduces water cement ratio, Increases the workability and improves early strength of RMC
2.	EO PO Co Polymer	APOL 61, APOL 62, APOL 64	Ethylene Oxide & Propylene Oxide co polymer	Low foaming emulsifiers
3.	Alcohol EO PO	AMINOCOPOL LAPE 63 AMINOCOPOL LAPE 54 AMINOCOPOL LAPE 84 AMINOCOPOL LAPE 45 AMINOCOPOL LAPE 36 AMINOCOPOL TAPE 64	Lauryl Alcohol 3EO + 6PO Lauryl Alcohol 4EO + 5PO Lauryl Alcohol 4EO + 8PO Lauryl Alcohol 5EO + 4PO Lauryl Alcohol 6EO + 3PO Isotridecyl Alcohol 4EO + 6PO	These are low foaming, Low toxic non-ionic emulsifier. Excellent biodegradable, having excellent wetting and dispersing action with high thermal and chemical stability. Due to low suface tension properties & effective rinse aid, suitable for dish wash and Industrial cleaners.
4.	Antioxidants	AMINO SP 120	Styrenated Phenol	Antioxidants for dry rubber and Latex. Acts as a stabilizer in polymers in combination with other phosphite & phenolic antioxidants.

APL'S ACID GAS TREATING PRODUCTS

Specialty Solvents	Applications
AMINOSOL CST® series AMINOSOL CSP® series AMINOSOL G® series	Provide maximum CO ₂ removal. Easier to regenerate and can be operated at higher lean loadings Almost no degradation products from reaction with CO ₂ Reduced solvent loss because of low foaming tendency
AMINOSOL® AMINOSOL HST™ series AMINOSOL HST™ HC series	Selective H ₂ S removal over CO ₂ . High CO ₂ slip. High Selectivity and superior performance than the generic amines Excellent chemical stability, lower energy requirements
ACTISOL-BF™ Series	CO ₂ removal in Ammonia Units. Suitable for Benfield Units. Less corrosive than MEA or DEA. Provide maximum CO ₂ removal. Performance superior than generic amines
AMINOSOL FGS® series	For CO ₂ Capture and Storage Applications (CCS)
AMEXOL®	A Physical solvent suitable for the absorption of H ₂ S, COS, CO ₂ and Mercaptans
AMINOSOL LG™ series	Suitable for Natural Gas Liquids Applications
AMINOSOL HYBRID™ series	Various Blends of Chemical and Physical solvents
AMINOSHALE® Series	Specialty Solvents Custom Made for Shale Gas Application
AMINOSOL FD™ Series	Specialty Solvents for Food Applications

NEUTRASOL®	HEATS TABLE AMINE SALT (HSS) NEUTRALISER SOLVENT
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SPECIALTY ADDITIVES	
CAT-1 BEN™	A Specialty formulated additive suitable for BENFIELD units

ANTIFOAMING AGENTS FOR GAS TREATING APPLICATIONS	
AMINOSOL AF-1® AMINOSOL AF-2® AMINOSOL AFS™ AMINOSOL AF-8®	High performance antifoams polyglycol, silicon and hybrid based to provide effective foam control in amine solvent and dehydration systems improving the overall performance

® Registered Trademark of Amines & Plasticizers Ltd., India

™ Trademark of Amines & Plasticizers Ltd., India



APL'S CARBON CAPTURE AND STORAGE (CCS) WITH AMINOSOL - FGS[®] TO REDUCE THE GREEN HOUSE GAS EMISSIONS

The carbon capture and storage (CCS) or the carbon sequestration is recognized as a potential solution for a long term mitigation of the CO₂ emissions.

Today there are various proven technologies for the CO₂ capture. However, the long term effect of the CO₂ storage into the ground or any other geological formations are still under consideration and trial-studies are underway worldwide.

The oil and gas industry is one of the main producers and users of CO₂. It is well known that the CO₂ is injected into depleting reservoirs in order to enhance the recovery of the oil.

In Ammonia and Urea Plants, the CO₂ produced by the reforming process and the CO₂ recovered from the flue gas are fed together to the urea synthesis section as a feedstock. This maximizes the urea production, reduces the CO₂ emissions and minimizes the reconstruction.

Amines have been used today successfully in various industrial applications and are the most common products for the CO₂ removal from the various gas streams which contain CO₂.

There are several amines tested, generic or specialties, available from various vendors. The choice of the most suitable amine depends on the gas composition, the product specifications and the operating costs.

The amine unit operating costs depend on the circulation of the amine, the energy needed for regenerating the amine, the cooling duty and the amine losses.

A typical feed gas composition of a power plant will contain Oxygen (O₂) at least about 5% (vol) and even more. There will be also other components like N₂, CO₂, H₂S, NO_x, SO_x, etc.

The presence of O₂ in the feed gas will cause the oxidative degradation of the amine leading to the formation of the Heat Stable Salts (HSS). The formation of the HSS in the amine used will have a negative effect on the operation of the unit, the quality of the amine and will attack the metallic surfaces of the equipment, especially the ones operating at elevated temperatures.

The removal of the HSS can be accomplished by installing units using the Ion-Exchange or Electrodialysis technologies or by Thermal Reclamation.

APL offers both technologies, Ion-Exchange and the Electrodialysis skid mounted units.

AMINES & PLASTICIZERS R&D, in Mumbai India, has developed a Specialty Amine, the AMINOSOL-FGS, which shows excellent resistance to oxygen degradation and minimum formation of HSS.



APL ENGINEERING SERVICES PVT. LTD.

An ISO 9001-2015 Certified Co.

APL ENGINEERING SERVICES

APL Engineering Services Pvt. Ltd. (an ISO 9001 - 2015 certified Company) is a subsidiary of Amines & Plasticizers Ltd.

Amines & Plasticizers Limited, the parent company has been in manufacturing of chemicals for various industries, primarily for Refineries, Fertilizer Complex, Petrochemicals, Pharmaceuticals etc., having its plant in Navi Mumbai and has been a leader in its field for last 35 years.

As part of diversification and to ensure availability of quality plant & equipments to suit the advanced technologies, APL Engineering Services Pvt. Ltd. was established for fabrication of vessels, Heat Exchangers, Columns, High end Plant Equipments, Pressure Swing Adsorption (PSA) beds etc.

LOCATION

The unit is located at Khopoli-Mumbai. The location is well connected by road to Expressway and old Mumbai Pune road. The JNPT Port / Nava Sheva is just 30 Kms away.

APL ENGINEERING SERVICES

- The unit is on a plot of 26 acres of land with an open area of more than 10 acres for fabrication works. The land area allows large space for movement of material and sufficient storage space. Open space for fabrication such as marking, cutting and sand blasting etc is available in plenty.
- The main shed is 25 meters width by 50 meters length (which can be extended by another 50 meters) with 8" thick solid concrete flooring to take a maximum load below the overhead crane.
- Connected power of 750 kVA
- Have established design and manufacturing capability of coded vessels and equipment required for chemical plants and various other industries through the services of experienced consultants in their respective fields.
- Follow Indian and American standards for design and manufacturing (IS-2825, IS-803, API- 650, BS-1500, ASME-TEMA, IBR. DIN etc.) ‘
- Has necessary team of Engineers, supervisors and skilled workers, testing and measuring instruments, material handling facilities, machinery, tools etc.
- Has experience of getting the jobs inspected by various recommended inspection agencies with all required documentation.
- neering is a Division of Amines & Plasticizers Ltd.



APL'S PANORAMA SOFTWARE

PAnORaMA IS A SUPERIOR SOFTWARE:

- For Accurate Pipe Leak Detection
- Capable of handling multi Products
- A Training Simulator
- SCADA System
- With Commercial Support
- Operation Friendly and Cost effective

PAnORaMA is based on a very robust simulation engine for flow of gas or liquid in a pipe network. The flow network can be a tree network or network with one or more loops. The simulation engine is developed by Piping Engineering Cell, IIT Bombay. The simulation engine is based on first principle transient model of compressible or incompressible fluid flow in a user defined network

PAnORaMA is an object oriented implementation and supports most requirements of piping network design, operation and maintenance. It is specifically suited to cross-country pipeline community.

PROCUREMENT OF PAnORaMA OR PAnDRaMA SERVICES:

Basic PAnORaMA comprises of modules 1-4 described above. It offers the user network simulation power. Modules 5-10 can be procured depending on the requirement. Any add-on support (#11) will be on developmental manpower basis.

The purchase will have to be for PAnORaMA for gas distribution, liquid distribution or both.

The software is available on 'seat' basis where user purchases one or more copies implemented at client's computing facility. The software is also available on 'rental' basis for limited period. The software can also be made available on 'services' basis where the client outsources the knowledge processes and PAnORaMA team provides on-site or remote services. PAnORaMA team is open to any other model.

The buy comes with a comprehensive training on domain concepts, software usage and backup.

All pricing is based on the network complexity and is computed on the basis of number of nodes in a network and total length of the pipe segments.

For parties new to the crosscountry business, this pricing philosophy affords a great opportunity as for initial simple network, PAnORaMA would come at a very reasonable price.

APL INFOTECH LTD. is a Subsidiary of Amines & Plasticizers Ltd.



ZEOCHEM®

Amines & Plasticizers Ltd. is a distributor of Zeochem AG Europe / Zeochem LLC USA molecular sieves and activated alumina in India. Zeochem was established more than 200 years ago and is a premier manufacturer of high-quality molecular sieves. Zeochem's proprietary manufacturing processes utilize the latest processing equipment and computerized process control systems to manufacture a wide range of high-quality adsorbents. Zeochem adsorbents are used in a variety of applications including Natural Gas Processing & Liquefied Natural Gas, Refining, Solvent Drying & Treating, Petrochemicals, Ethanol Dehydration, Ammonia Syngas, Industrial Oxygen Generation, Hydrogen Purification and Industrial Drying.

As a distributor and stockiest in India APL sells Zeochem molecular sieves on indent basis (direct import by customers from Zeochem manufacturing locations) and on stock and sales basis. APL continually stocks molecular sieves in a Mumbai warehouse in order to meet customer requirements while also providing after sale service. Zeochem also offers technical support and provides recommendations for different grades and applications. Zeochem's Technical Service Engineers evaluate customer processes and provide recommendations for optimization of operations.

Zeochem provides coordinated global support with manufacturing facilities in the US, Switzerland, China and Bosnia and Herzegovina. Each location maintains inventory in order to meet customer requirements. Zeochem continually invests in new technology and providing solutions for expanding markets. They also have been and continue to invest in R&D to develop new molecular sieves which will provide added value to their customers. Zeochem's team of Technical Services Engineers support customers in selecting the ideal product grade and make design recommendations for each application. Zeochem uses the highest quality raw materials and follows stringent global quality control procedures.

Products manufactured by Zeochem are tested in their quality control laboratory independently from the manufacturing process. Zeochem uses test methods in accordance with international standards and has also developed proprietary procedures. Zeochem is an ISO 9001:2015 certified company.

ZEOCHEM Molecular Sieve Adsorbents

Zeochem manufactures a wide range of zeolites used as molecular sieve adsorbents. Some of the more common types of molecular sieves and some typical applications include the following:

Type 3A:

Will exclude most molecules except water. Type 3A is used for drying natural gas, ethanol and reactive monomers such as olefins etc. Type 3A is usually made by ion-exchanging potassium onto Type 4A in place of sodium.

Type 4A:

The sodium form of Type A is widely used as a general purpose drying agent. Under certain conditions it can also be used for removal of carbon dioxide.

Type 5A:

This is the calcium-exchanged form of the Type A zeolite. The strong ionic forces of the divalent calcium cation make 5A an excellent choice for removing carbon dioxide, carbon monoxide, hydrogen sulphide and other weak polar molecules. This product is also effective for the bulk separation of normal and iso-paraffin hydrocarbons.

Type 13X:

The sodium form of zeolite X has a much larger pore opening than the Type A crystals. It also has the highest theoretical capacity of the common adsorbents and very good mass transfer rates. Type 13X removes impurities too large to fit into the Type A zeolites and is also often used to separate nitrogen from air to produce a high purity oxygen stream.



APL'S AMINES ANALYTICAL SERVICES

APL provides comprehensive analysis of the amine which is used in every amine unit. The amine analysis provides an advanced warning of potential problems.

The APL amine analysis will show, and therefore evaluate, the amine degradation, monitor the levels of contaminants, monitor excessive plant corrosion and corrosive conditions and it is a tool to manage the changes of the formulation.

The routine amine analysis includes the colour, water content and amine strength.

The periodic amine analysis includes the strength of the amine, the gas loading, foaming and the heat stable salts(HSS).

The trended results/data is an important tool which will assist the amine unit operator and the amine vendor to do an effective troubleshooting.

The APL program of amines analytical services compliments the analysis carried out by the amine user and includes:

1. Free quarterly sample analysis for the APL customers
2. Quarterly checks of the amine condition and the process which are essential to monitor and know, amine concentration, metals, impurities, and degradation products.
3. At the APL laboratories a data base is maintained for every customer and every amine unit which is used to monitor the performance of the amine unit over time.
4. The collected data are studied, trended and analysed in order to improve the performance of the amine unit.

Amine analysis carried out at the APL Laboratories:

- Amine strength
- HSS Content
- Metals by ICP
- Anions by Ion Chromatography (whenever required)
- Degradation Products and other impurities
- Foaming Tendency
- Monitor the reclamation results
- Sample colour
- pH test
- CO₂ and H₂S loadings mol/mol
- Corrosion tests

For the Packaging and Shipping the lean amine samples APL will provide the sample kits for shipping safely and efficiently the lean amine samples.

The box provided by APL includes sample bottles, packing materials, instructions on how to safely package, illustrations, the necessary labels, the SDS and information on the customs regulations.

APL'S TYPICAL SAMPLE ANALYSIS REPORT



Customer: _____
 Sample Number: _____
 Sample Date: _____
 Received: _____
 Completed: _____

Date: _____ Date: _____ Date: _____

AMINE CONCENTRATION

Alkalinity Titration, wt%			
Additive(s) Level wt%			

METALS BY ICP

Chromium (Cr) (PPM)			
Copper (Cu) (PPM)			
Iron (Fe) (PPM)			
Potassium (K) (PPM)			
Sodium (Na) (PPM)			
Nickel (Ni) (PPM)			
Calcium (Ca) (PPM)			
Silica (SiO ₂) (PPM)			

ACID GAS LOADING

H ₂ S (Wt %)			
H ₂ S Mole /Mole			
CO ₂ Wt %			
CO ₂ Mole /Mole			
Total Acid Gas Loading Mole/Mole			

HEAT STABLE SALTS

Heat Stable Amine Salts, Wt % Amine			
Inorganic Heat Stable Salts, Wt% Amine			
Total Heat Stable Salts, Wt % Amine			

pH OF AMINE SOLUTION AND FOAM TEST

pH			
Foam Height			
Break Time			

CORROSION TEST

Corrosion Rate(mpy)(CS)			
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ANIONS BY ION CHROMATOGRAPHY (IF REQUIRED)

Chlorides (PPM)			
Oxalates (PPM)			
Sulphates(PPM)			
Formates (PPM)			
Acetates (PPM)			
Thiocyanates (PPM)			
Thiosulphate (PPM)			

AMINE PURIFICATION SERVICES FOR RECLAIMING AMINES ON - SITE AND ON- LINE

- APL PROVIDES AMINE HYGIENE AND AMINE SOLVENT MANAGEMENT TO:
Refineries, Acid Gas Treating, Ammonia and Steel Industry plants.
- APL provides two well established technologies for amine purification, these are:
ION EXCHANGE (IX) & ELECTRODIALYSIS (ED).
- The skid mounted filtration units provided by APL will deal with corrosion, hydrocarbon entrainment, filtration, heat stable salts and foaming issues.
- The IX or the ED units will process a slipstream of amine on-line or amine stored in a tank.
- The primary benefits are: removal of Heat Stable Salts (HSS) and degradation products leading to increased capacity, reduced corrosion, more stable operating conditions and reduced amine consumption.

THE AMINES WHICH WE PROCESS WITH THE IX OR ED UNITS

MEA, DGA (Primary Amines)

DEA, DIPA (Secondary Amines)

MDEA, TEA (Tertiary Amines)

DEA/MEA/MDEA/PIPERAZINE BLENDS

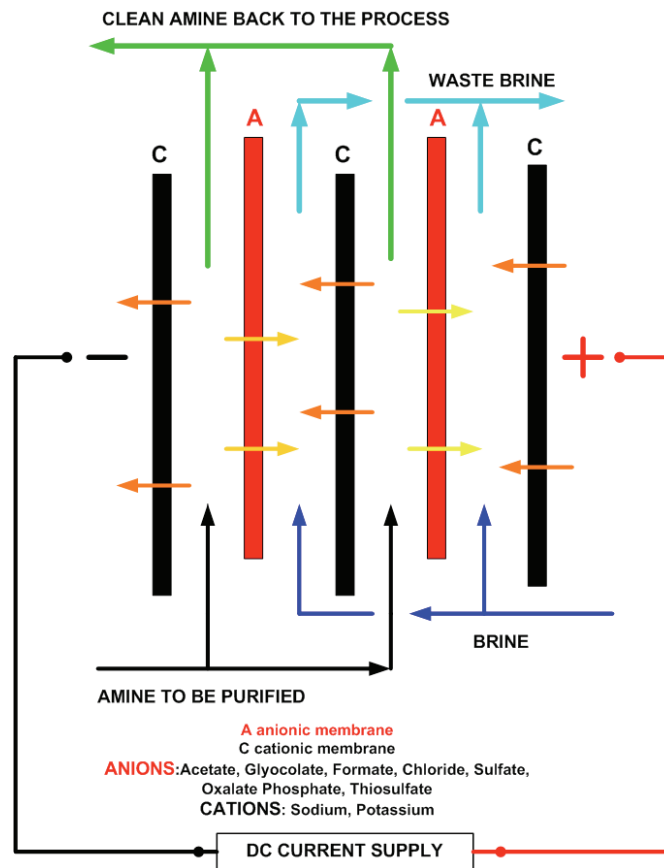
ANY OTHER BLENDS: These can be tested on the field by the portable testing unit of APL



ED MEMBRANE STACK

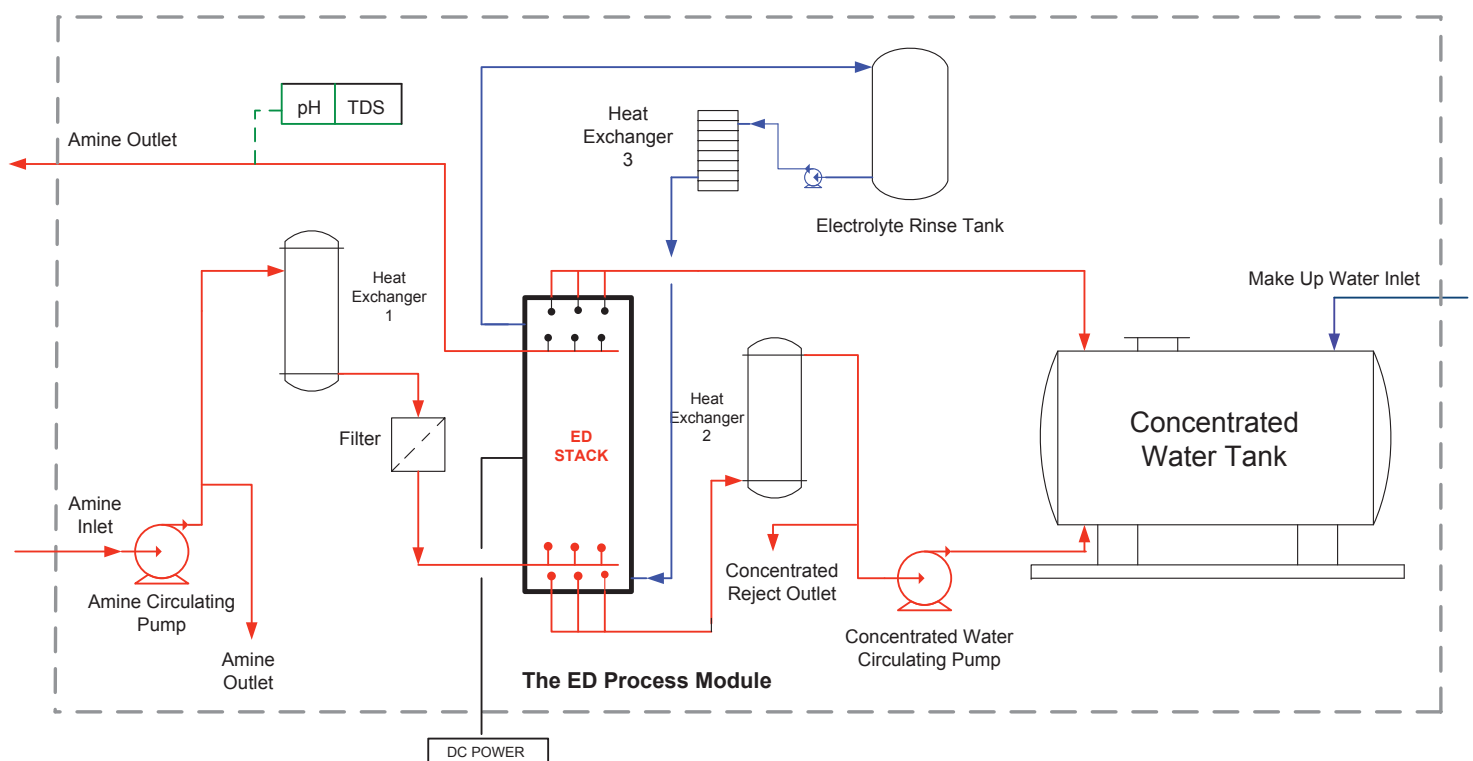
Model	HNED-150	HNED-200
Membrane numbers	150	200
Membrane area	181.5m ²	242m ²
Standard processing capacity	10m ³ /h	10m ³ /h
Equipment power consumption	40kw	40kw
Max removal rate of HSS	≤ 30KgHSS/h	≤ 40KgHSS/h
Equipment size	6x2.5x2.5M	6x2.5x2.5M

TYPICAL MODELS AND CAPACITIES OF ELECTRODIALYSIS SKID MOUNTED UNITS



The Principle of Electrodialysis

A direct current is applied to electrolytic cells and creates a charge imbalance. This will cause the ions in the conducting solution to migrate into the electrodes with opposite charge. The anions: chlorides, acetates, formates, etc., will migrate to the positive side. The cations: sodium etc., will migrate to the negative side.



MODELS AND CAPACITIES OF ION EXCHANGE UNITS

Names of Streams	APL-DHSS-6-ST588			APL-DHSS-6-ST688			In/out
	High HSS	Medium HSS	LOW HSS	High HSS	Medium HSS	LOW HSS	
Income amine (L/cycle)	90	180	360	100	220	>460	In
Demineralized water (L/cycle)	102.6			151.5			In
Regenerated wastes (L/cycle)	35			55			Out
Rinse wastes (L/cycle)	10			15			Out
Dissolved water in amine (L/cycle)	60			85			Out
30%NaOH (L/cycle)	2.4			3.5			In
HSS removal capacity (Kg HSS/h)	1.5			2.0			
Number of Recycles (n/hr)	1-20			1 - 20			
Power consumption (kwh/cycle)	0.8			1.0			
Nitrogen gas consumption (m ³ /cycle)	0.2			0.2			

The Ion Exchange (IX) skid mounted units offered by APL are fully automatic and can be easily integrated into an amine unit. The IX unit operates continuously and treats a slip stream normally after the amine filtering unit-lean amine cooler and removes the HSS from the amine circuit. The HSS removal is done at a specified rate in order to offset the build-up rate of HSS. The IX units of APL are available in various standard models providing the HSS removal requirements of the customers. The selection/offer of the model to meet the HSS removal requirements is based on the data provided by the amine unit operator. APL has a data gathering/evaluation form.

NOTES ON CONTAMINANTS IN AMINES TO HELP AVOID THE CONFUSION OVER THE TERMS HSS AND DEGRADATION

There are five groups of contaminants in amines:

1. THE WELL-KNOWN HEAT STABLE SALTS(HSS)

These are the strong acid ANIONS, i.e. formate, thiosulfate, acetate, thiocyanate, oxalate, sulfate, and chloride. These can tie up an amine molecule and form a salt which cannot be regenerated by heat. Therefore, these are referred as HEAT STABLE SALTS (HSS).

The HSS will tie up the amine and reduce the acid gas capacity, the HSS are also corrosive. The HSS are one type of contaminants. The HSS are not the most offensive and are not degradation products. A complete and thorough amine analysis will be reporting the HSS and the degradation products separately.

2. THE DEGRADATION PRODUCTS

These are the contaminants in the amine solution resulting from the breakdown of the base amine molecule and will form totally different chemical species.

The degradation products are usually inert. They can cause also an increase of the solution viscosity, density, reduced water content, reduced surface tension and as a result reduce the available amine. They are also contributors to corrosion. These can also lead to fouling, foaming and high production of flash gas.

Some of the degradation products in primary or secondary amines include the amides, namely: FORMYL-MEA, FORMYL-DEA, FORMYL-DIPA. Another family of degradation products found in primary and secondary amines are the OXAZOLIDONES. Amino acids such as BICINE, are degradation products in amine units using tertiary amines such as MDEA. The analysis of degradation products in an amine solution is not simple. The procedure requires very experienced laboratory personnel, sophisticated expensive instruments and well established analytical methods.

It will be noted that a field analysis will serve only the purpose of maintaining the amine solution strength, check the stripping efficiency and the circulation rate. The measurement of alkalinity and the acid gas components will accomplish these goals.

However, these measurements and values will tell to the operator nothing on the condition of the amine degradation. It is very common to find extensive degradation of a solvent having MEA/DEA/MDEA without the plant operation/process personnel being aware of the problem.

3. THE HYDROCARBONS

The heavy hydrocarbons in the natural gas streams can cause severe problems when condensing in the contactor. Also the lubricants from upstream compressors can be accumulated in the amine unit solution over time. The hydrocarbons will cause foaming and as their concentration increases can have an effect on the physical properties of the amine.

4. THE INJECTION CHEMICALS

These include the corrosion inhibitors, the antifoam agents, the HSS neutralizing agents which will concentrate in the amine solution over time and over the years can reach a substantial percentage of the amine concentration. A large concentration of these chemicals can lead into fouling and change of the amine solution physical properties.

5. THE PARTICULATES

These are various insoluble particles like iron sulfides, corrosion metals, carbon particles from the amine carbon filters and catalyst fines from upstream units.

THE HSS BUILD-UP IN AMINE UNITS

These are the five most likely routes to building-up HSS in amine units

1. The Absorption/Addition of the strong acid anions, for example the sulfate, chloride, and phosphate.
2. The Oxidation of the H_2S , for example the thiosulfate, and the sulfate.
3. The Oxidation of the alcohol of the amine in use, for example the acetate, oxalate and the formate.
4. The Reaction of the HCN (hydrogen cyanite) from synthesis gas process and/or the nitriles form HSS. For example: the formate, thiocyanate and acetate.
5. The Hydrolysis of carbon monoxide (CO) which is catalysed by the metals, example is the formate.

The HSS in an amine solution will reduce the amount of amine available for removing the acidic components of the gas and will increase the operating problems and the corrosion of the amine in use.

The first two steps dealing with HSS are:

1. The elimination of the HSS precursors in the incoming gas or make-up water.
2. The intermediate treatment of the amine solution by adding NEUTRASOL® for converting the amine salts to sodium or potassium salts will increase the amine available for removing acidic components in the gases and will reduce the operating problems.

The final treatment will be the reclamation/purification of the amine solution to reduce the HSS level or the replacement of the used amine with fresh amine solution.

It will be noted that the addition of NEUTRASOL can be justified when the operator wishes to extend the operating life of the amine solution. It is only a temporary solution.

The addition of NEUTRASOL will neutralize the HSS and it must be done carefully and slowly. There is a practical limit of NEUTRASOL addition which is 70% to 80% total sodium and/or potassium in the TOTAL SOLUTION.

APL offers its own neutralising agent, the NEUTRASOL. This neutralizer is designed specifically by APL to effectively and safely neutralize the HSS.

APL has developed the APL HSAS-C™ to help operators calculate and manage the HSS in their amine units. The APL HSAS-C can be downloaded, free of charge, from:



It can also be used online at: [www.amines.com/gas treating products & technologies/calculators](http://www.amines.com/gas%20treating%20products%20&%20technologies/calculators)

NEUTRASOL® is a registered trademark of Amines & Plasticizers Ltd., India

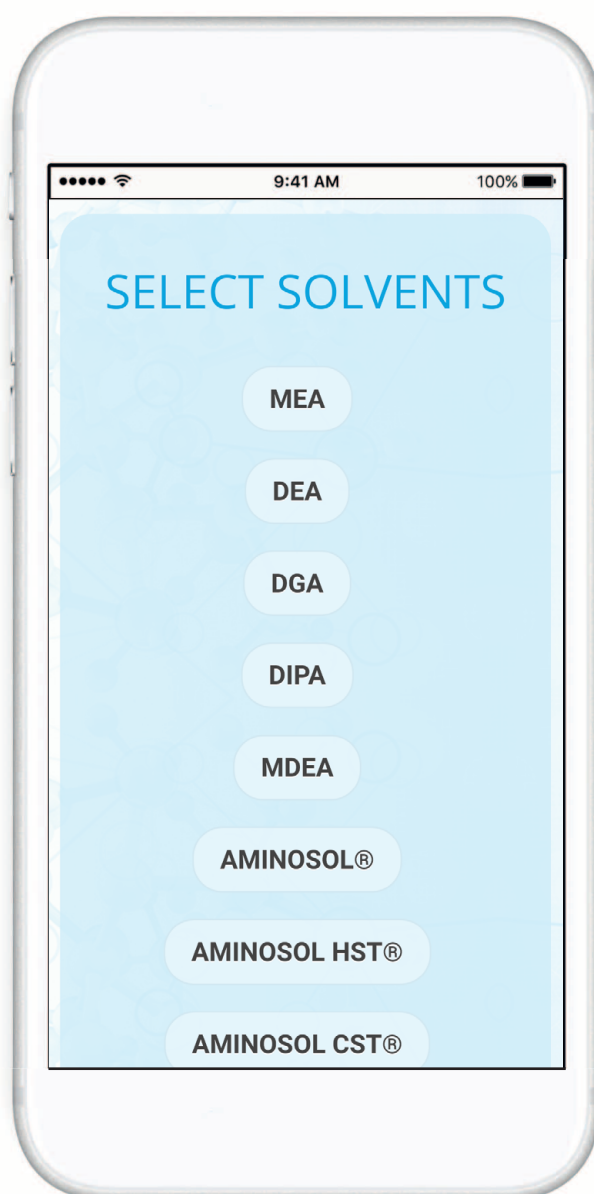


HSAS-C App

For an effective HSS management APL has a developed the APL HSS-C (™) App to help operators calculate and manage the HSS in their amine units and apply neutralisation if required.

Open the
HSAS-C (™) App

Select solvent and
enter parameters.
Follow the steps of the APP



THE 10 APL AMINOSOL ADVANTAGES

- 1 Competitive prices and local storage
- 2 APL provides blended solvents per customer requests or similar solvents from the APL AMINOSOL series of specialty amines

3 THE BLENDS PROVIDED BY APL INCLUDE: MDEA, PIPERAZINE, SULFOLANE, HEP, MTG, OTHER

- 4 Increase the capacity of the amine units
- 5 Energy savings and increase of selectivity
- 6 Remove mercaptans with APL AMINOSOL HYBRID solvents
- 7 SYN-GAS and SRU tails gas treating
- 8 COAL GASIFICATION & LAND FILL applications
- 9 Carbon-Capture-Storage with AMINOSOL-FGS®
- 10 APL offers HSS removal with ION EXCHANGE (IX)
or ELECTRODIALYSIS (ED) skid mounted units for
On-Site or On-Line solvent purification

APL'S OFFERING

TECHNICAL SERVICES

- Amine Process Simulations
- Pre-Start Up Trainings
- Start-Up Assistance
- Operational Optimisation
- Periodic Audits of Operation
- Turn Around Unit Inspections
- Unlimited Simulation Support
- Awareness on New Solvent Blends and Developments
- 24hr Online Troubleshooting

ENGINEERING SERVICES

- Equipment Specifications/Guidelines
- Materials of Construction and Selection Recommendations
- Evaluation and Pilot Plant Studies

ANALYTICAL SERVICES

- HSAS Analysis & Amine Neutralisation
- Rich/Lean Loadings Amine strength
- ANIONS by Ion Chromatography
- CATIONS by ICP
- Gas Chromatography
- Corrosion Testing
- Monthly or Per User Request Analytical Reports on the condition of the Amine used
- Interpretation of Results

DATA REQUIRED FOR THE DESIGN OF THE APL HSS REMOVAL UNIT

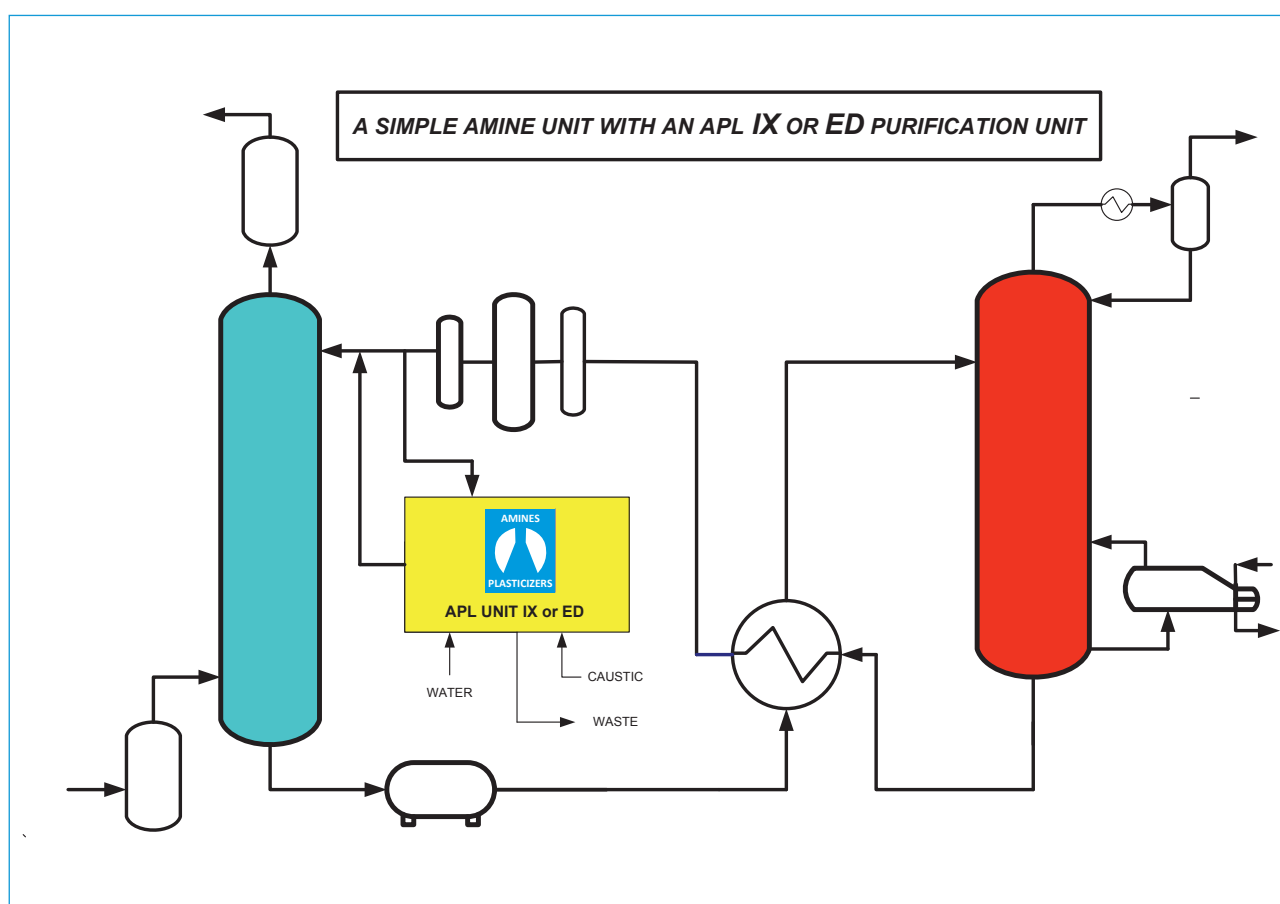
To: AMINES & PLASTICIZERS LIMITED
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 DR. ANNIE BESANT ROAD, WORLI
 MUMBAI-400018
 INDIA

Fax: +91 22 24938162
 Email: amines@vsnl.com
 Email: gastreating@amines.com

Date: _____

CUSTOMER INFORMATION:

Company:	
Contact Person:	
Location:	
Phone:	Fax:
E-mail:	



DATA REQUIRED FOR THE DESIGN OF THE APL HSS REMOVAL UNIT

- 1) Name of Amine Solvent currently used = _____
- 2) Inventory of amine solution in the system = _____ m³
- 3) Current amine concentration = _____ wt%
- 4) Current Total HSS (Heat Stable Salt)
(wt% as equivalent amine) = _____ wt%
- 5) Current HSAS (Heat Stable Amine Salt) Concentration = _____ wt%
(wt% as equivalent amine)
(Please provide similar data of Total HSS and HSAS for last one year)
- 6) CO₂ Lean Amine Loading (or wt%) = _____ mol/mol
- 7) H₂S Lean Amine Loading (or wt%) = _____ mol/mol

Anions content in the lean amine in ppm (Enter whatever data available)

Anions	Current Values	Previous Quarter 1	Previous Quarter 2	Previous Quarter 3	Previous Quarter 4
Formate ppm					
Acetate ppm					
Chloride ppm					
Sulphate ppm					
Thiosulphate ppm					
Thiocyanate ppm					
Glycolate ppm					
Nitrate ppm					
Total Anions ppm					

Cations contents in the lean amine in ppm (Enter whatever data available)

Cations	Current Values	Previous Quarter 1	Previous Quarter 2	Previous Quarter 3	Previous Quarter 4
Chromium (Cr) ppm					
Copper (Cu) ppm					
Iron (Fe) ppm					
Potassium (K) ppm					
Sodium (Na) ppm					
Nickel (Ni) ppm					
Calcium (Ca) ppm					
Silica (SiO ₂) ppm					
Total Cations ppm					



ION EXCHANGE

ELECTRODIALYSIS

FILTRATION



THERE ARE OVER 40 IX
UNITS INSTALLED

For more information contact us at:

AMINES & PLASTICIZERS LTD.

(AN ISO 9001-2015, ISO 1400-2015, OHSAS 18001-2007 CERTIFIED COMPANY)

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