

Predict-Amine

Product Information Note

Predict®-Amine is the only system of its kind, enabling Amine Unit operators in Gas Plants and Refineries to predict / quantify corrosion in rich and lean amine systems and select optimum metallurgy for these corrosive applications.

Amine corrosion is a key contributor to asset degradation and failure in Gas Plants and Refineries. Accurate quantification of corrosion is critical in enabling improved assurance in safe utilization of steels in Amine units.

The Predict-Amine Corrosion Prediction Software System encapsulates inferences, experimental results, and research data from three phases of a Joint Industry Program (JIP) conducted by Honeywell and sponsored by global, leading refining and engineering companies. These multi-year research programs resulted in the development of quantitative engineering databases and a decision-support model to predict corrosion in Amine systems as a function of critical environmental components, such as solvent type (MEA, DGA®, DEA and MDEA), H₂S loading, CO₂ loading, temperature, heat stable amine salts (impurities) and multiphase, hydrodynamic parameters.

Corrosion Prediction Made Easy

Predict-Amine offers an intuitive user interface that takes little time to master and delivers results quickly.

The user interface presents pertinent inputs needed to quantify corrosion in amine systems. These inputs are the commonly available process parameters such as:

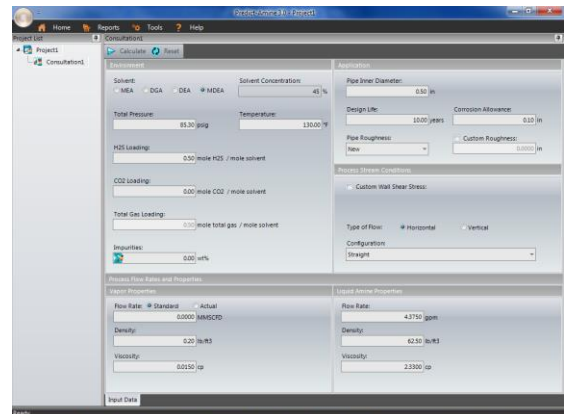


Figure 1: Predict-Amine 4.0 program input interface, showing relevant inputs required for corrosion prediction

FEATURES & BENEFITS

- Reduce Capital Expenditures
- Optimized metallurgy selection for various locations
- Improve Safety and Reliability
- Identify unsafe Operating Conditions for installed materials
- Prevent failures during design through systematic material selection
- Reduce Operating Risk
- Identify conditions where high corrosion rates are possible
- Run what-if scenarios analyses to identify critical locations for varying operating conditions
- Simplify and Standardize Material Selection Process
- Consider cracking, pitting and corrosion as part of root cause and failure analyses

- Operating conditions - pressure, temperature, solvent type, etc.
- Application information - pipe ID, corrosion allowance, etc.
- Process flow rates and properties including vapor and liquid amine properties

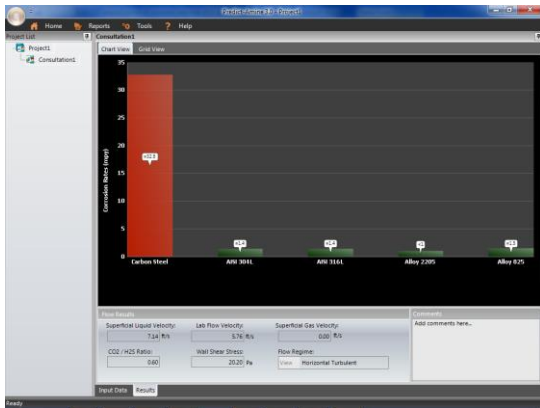


Figure 2: Predict-Amine 4.0 program output interface, showing corrosion predictions

Once the input data is entered, Predict-Amine performs an in-depth analysis and generates:

- Predicted corrosion rate for five metallic materials commonly used in Amine Unit applications (expressed in MPY or MMPY)
- Flow induced wall shear stress
- Flow parameters such as superficial liquid velocity, superficial gas velocity etc.
- Flow regime visualization occurring in specific piping sections

Features

Predict-Amine offers the following critical functionality:

- Prediction and assessment of corrosion in amine systems as a function for solvent, H₂S loading, CO₂ loading, velocity (wall shear stress), and various additional parametric variables
- Data for relevant materials, ranging from

carbon steel to Alloy 825

- A multi-phase flow modeling module correlating key flow parameters and corrosion rates to quantify contribution of typical flow-induced corrosion parameters
- Ability to accurately model momentum transfer effects (flow regimes, void fractions, pressure drops and shear stresses) to support improved corrosion prediction
- Ability to incorporate effects of impurities in amine systems
- New three-dimension piping model that shows predicted corrosion rates across complete piping systems
- Enhanced heat stable amine salt effect characterization
- Study parametric effects with sensitivity analysis tool
- Perform Multi Point Analysis using MS Excel
- On-the-fly and secure, electronic access to actual laboratory test data and program reports from JIP research
- Supports generation of extensive data reports, multiple case analyses and data-sharing across platforms
- Extensive Online Help System that guides users to effectively use the software and accurately interpret program results
- Availability of Real-Time (RT) version of Predict-Amine that may be easily linked to any process historian (such as Uniformance® PHD) and/or DCS to provide real time corrosion data

New Enhancements

- New data and program report from Lean Amine - Phase III JIP

Predict-Amine 4.0 is the only system of its kind, enabling Amine Unit operators in Gas Plants and Refineries to predict / quantify corrosion in rich and lean amine systems and select optimum metallurgy for these corrosive applications.

Benefits

- Intuitive graphical interface facilitates ease of learning and access
- Effectively characterize and predict corrosion and identify appropriate, corrosion resistant material (when carbon steel may not be suitable)
- Helps in the development and implementation of Integrity Operating Windows (IOW)
- Extensive on-line help assists the user in understanding the significance of different corrosion evaluation parameters and their effects
- Easily perform analysis of complete pipeline systems with corrosion prediction and flow modeling for horizontal/vertical pipe sections
- Pin-point parameters contributing to corrosion and helps in development of effective mitigation strategies
- Quantify, characterize and analyze amine systems and prevent unscheduled shutdowns
- Access to extensive consulting and development support from Honeywell International Inc. in using Predict-Amine

Analyzing piping network with ease

The latest developments in graphical piping simulation have been made available in Predict-Amine, providing users the ability to map piping networks for comprehensive amine unit applications. A typical piping network with Straight Piping, T-Joints and Elbows can be easily recreated in Predict-Amine and results at each location may be analyzed with the click of a button.

This tool provides users the capability to analyze piping systems for corrosion rate prediction including bends, elbows, weld protrusion etc. and view corrosion rates for different materials of construction at different unit locations.

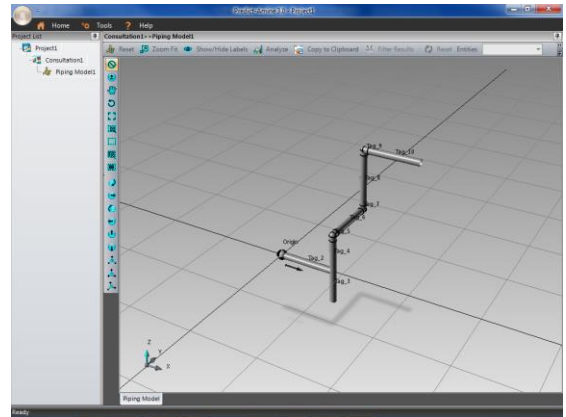


Figure 3: Predict-Amine 4.0 Piping Network

Secure Access to JIP Data

Users can securely and electronically access all laboratory test data and program reports utilized to develop the Predict-Amine model.

Predict-Amine is the only system of its kind, giving refinery operators the ability to quantify corrosion in rich amine systems and plan safe operating procedures. This provides planners and plant managers the ability to make appropriate financial and engineering decisions related to material performance and selection for rich amine applications.

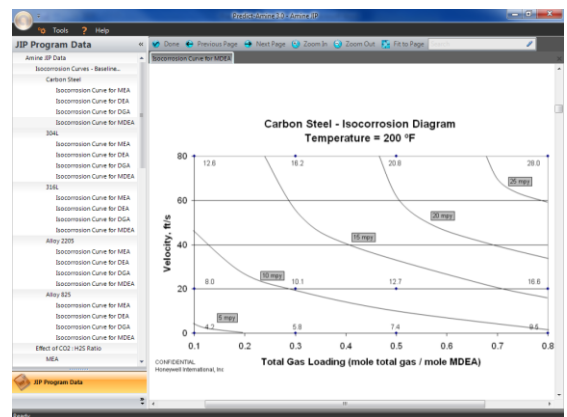


Figure 4: Predict-Amine 4.0 JIP data for carbon steel

Building a Standard Work Process for Corrosion Prediction and Material Selection

The use of a modeling application like Predict-Amine allows a company or site to evaluate corrosion problems consistently and with high accuracy and repeatability. Predict-Amine is built

upon a multi-faceted, foundation of corrosion knowledge, including proprietary data from hundreds of laboratory tests carried out during multiple Joint Industry Project (JIP) on Amine Corrosion, extensive literature information, accurate multiphase flow modeling.

Because Amine corrosion in multiphase CO₂ and H₂S systems is an extremely complex phenomenon, the only way to model corrosion is to utilize laboratory test data generated under simulated flowing conditions. The JIP corrosion test conditions incorporate simulated flowing conditions and that data helps in formulation of rules correlating critical parametric relationships. Predict-Amine also incorporates rigorous mechanistic models for phase behavior, ionic analyses and flow modeling. This integration of first principles and real engineering data provides Predict-Amine the unique foundation to accurately predict corrosion under a wide range of operating conditions relevant Amine units. The result is that Predict-Amine is the only system available today whose numerical model is built upon real corrosion laboratory testing data integrated with rigorous flow and ionic modeling.

With an underlying foundation based upon real corrosion research and first principles, Predict-Amine uses a practical approach to modeling corrosivity:

- First, provide a predictive model that utilizes commonly available environment and operating parameters
- Second, utilize existing lab data, field data, or theoretical models to obtain realistic assessments of corrosivity and corrosion rates
- Third, include a computational approach that integrates both numerical and heuristic (field data and experience) information and knowledge about corrosivity prediction

Most other predictive models tend to be either very conservative in their interpretation of results or focused on a very narrow range of parametric effects; these approaches do not lend themselves to a practical application for predicting corrosivity or corrosion rates in Amine Units where the ability to characterize effects of all the relevant parameters has to be complemented by an accurate basis for doing so.

With the foundation in place and confidence in an application built upon rigorous corrosion principles and data, users have built their standard working practice for corrosion prediction and material selection on Predict-Amine.

Honeywell Predict® Corrosion Suite

Honeywell Predict Corrosion Suite provides next generation corrosion management solution for oil and gas and refining industries seeking to move from reacting to corrosion damage to a more proactive and effective approach. Honeywell Predict® Corrosion Suite provides the next generation of corrosion management solutions. Unlike conventional corrosion management methods, we employ unique prediction models that encapsulate deep expertise and extensive process data to correlate corrosion rates to specific process units, damage mechanisms, and operating conditions. Using Honeywell's tools, global major companies have achieved significant operational and business benefits.

The Honeywell Predict Corrosion Suite is a unique solution for today's industrial facilities, driving a paradigm shift in tackling difficult corrosion problems, and enabling efficient and safe operations. These software tools help users move away from a reactive response to corrosion based on qualitative, manual inspections, to a proactive, reliability-centric predictive approach based on quantitative information from soft sensors, sound process deviation management, and "what-if" scenario analysis tools.

For More Information

Learn more about Honeywell's Corrosion Solutions, visit www.honeywellprocess.com/Corrosion or contact your Honeywell Account Manager, Distributor or System Integrator.

Honeywell Process Solutions

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Why Honeywell?

Your operation can benefit from partnering with a proven leader in corrosion asset integrity and preventive/predictive corrosion management. Honeywell has extensive intellectual property in the corrosion field, including unique corrosion prediction and material selection models, and patented corrosion monitoring technology. Our deep expertise includes an in-house team of experts with decades of experience in developing corrosion solutions. Honeywell's IP-based models are licensed and used by many global oil & gas majors, and our company has a recognized track record of world-class execution of projects.

Honeywell has also established a unique corrosion knowledge community through our Center of Excellence (COE). We assist customers with expert local and remote support. Our state-of-the-art corrosion and materials research and engineering laboratory provides a host of standard and tailored services. Utilized in Joint Industry Programs and customized testing, this facility can simulate any service environment.

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