DEVELOPMENT AND OPTIMISATION OF A PREDICTIVE RELATIONSHIP BETWEEN CORROSIVITY AND ENVIRONMENTAL PARAMETERS FOR A POWER STATION MICROCLIMATE

David Druskovich, PhD, School of Chemical and Biomedical Sciences,
Central Queensland University, Rockhampton, Queensland, Australia, 4702.

Peter Best, PhD, Katestone Scientific Pty Ltd, Toowong, Queensland, Australia, 4066.

ABSTRACT

Corrosivity measurements at eight sites over a one year period near a coal-fired power station in Central Queensland have been interpreted in light of detailed, concurrent air quality and meteorological measurements, and with the aid of a comprehensive dispersion model for sub-tropical regions. The (limited) measurements suggest that there may be a doubling of short-term corrosivity on mild steel plates in areas close to the power station that experience enhanced ground-level concentrations of combustion gases. The mild steel corrosivity at the control site, measured over three months, was 23 μm/year.

As corrosion in a sub-tropical environment 50-80 km from the coast can have several causes, evaluation of exposures to microclimate and pollutants utilised detailed numerical modelling schemes in conjunction with emission information and site monitoring. Meteorological variability between control and test sites was predicted to be small. Chloride contributions were expected to be uniform and relatively small, based on evidence from similar sites in Australia. Treatment of repeat, three-month corrosivity field data allowed first-order regression equations to be developed between measured corrosivity and atmospheric pollutant exposure.

Careful experimental measurement, in conjunction with a reliable dispersion model, can lead to the development of first-order corrosivity maps for a microclimate. The maps can be useful for the assessment of future industrial scenarios in a region.

INTRODUCTION

Corrosivity is the estimation of the degradation of the properties of a material (such as a metal surface) as a consequence of exposure to an atmospheric environment. In any particular air shed, the corrosivity will be influenced by numerous factors, the most important being meteorological determinants (temperature, ultra -violet levels, relative humidity, time of wetness and wind direction and speed) and the presence of contaminants (such as sulfur dioxide, nitrogen oxides, ozone or particulates) [1]. Indeed the microclimate of a corrodible material is of prime importance in determining the corrosivity. For example, sheltering can reduce windspeed and the flux of pollutants but it may result in a greater time of wetness resulting in an enhanced corrosivity [2]. Furthermore, the general meteorological conditions (which vary with topographic setting) can influence the exposure to salt-laden winds or pollutants from nearby or distant sources, as well as affect the rates of the processes occurring at the moist air/metal interface.