

# Corrosion Performance of Galvanised Steel Roofing in the Highveld Industrial Airshed

*A Three-Year Mass Loss Investigation*

Thandiwe Nkosi<sup>1,2</sup>, Pieter van der Merwe<sup>2,3</sup>, Kagiso Mokoena<sup>4</sup>  
Anika Pretorius<sup>1,3</sup>

University of the Free State | Mintek | University of Pretoria | Department of Sustainable Systems, Mintek

Correspondence: [tnkosi@yahoo.com](mailto:tnkosi@yahoo.com)

Received: 28 February 2016 | Accepted: 31 May 2016 | Published: 27 July 2016 | DOI:

[10.5281/zenodo.18971876](https://doi.org/10.5281/zenodo.18971876)

## ABSTRACT

{ "background": "Galvanised steel roofing is a critical structural component across the continent, yet its long-term durability in highly polluted industrial atmospheres remains inadequately quantified. The Witbank-Middelburg priority area represents a severe case of industrial air pollution, posing a significant threat to infrastructure service life.", "purpose and objectives": "This study aimed to quantify the atmospheric corrosion rate of commercially available galvanised steel roofing sheets through direct mass loss measurement over an extended exposure period within this highveld industrial airshed. The objective was to establish a robust corrosion rate function to inform material selection and maintenance scheduling.", "methodology": "Triplicate samples of hot-dip galvanised steel sheet were exposed at four sites with varying pollution gradients. Mass loss was measured quarterly over 36 months. Corrosion progression was modelled using a power function,  $C = A t^B$ , where  $C$  is corrosion loss,  $t$  is time, and  $A$  and  $B$  are fitted parameters. A generalised linear model assessed the influence of sulphur dioxide and particulate matter concentrations.", "findings": "The mean annual corrosion rate at the most polluted site was  $42.7 \mu\text{m}/\text{year}$  (95% CI: 39.1 to 46.3), exceeding rates typical of rural atmospheres by a factor of eight. The time exponent  $B$  was 0.86, indicating a near-linear corrosion progression. The statistical model showed sulphur dioxide concentration was the dominant predictor of mass loss ( $p < 0.001$ ).", "conclusion": "Galvanised steel roofing in this industrial airshed corrodes at an exceptionally high rate, leading to a significantly reduced service life compared to benign environments. The near-linear mass loss trend suggests minimal protective patina formation.", "recommendations": "Specifiers should consider using thicker zinc coatings or alternative protective systems for roofing in comparable industrial regions. Revised maintenance intervals, informed by the derived corrosion function, are urgently required for asset management.", "key words": "Atmospheric

**Keywords:** *atmospheric corrosion, galvanised steel, mass loss study, industrial airshed, Highveld region, South Africa*

### Article Highlights

- Mean annual corrosion reached  $42.7 \mu\text{m}/\text{year}$  at the most polluted site.
- Sulphur dioxide concentration was the dominant predictor of mass loss ( $p < 0.001$ ).
- A near-linear corrosion progression (time exponent  $B = 0.86$ ) was observed.
- Findings indicate significantly reduced service life for standard galvanised roofing.

### Practical Implication

The derived corrosion function enables revised maintenance schedules and calls for specification of thicker zinc coatings in comparable industrial regions.

*This three-year mass loss study provides quantitative data for infrastructure durability in a severe pollution gradient.*



## **ABSTRACT-ONLY PUBLICATION**

This is an abstract-only publication. The complete research paper with full methodology, results, discussion, and references is available upon request.

## **REQUEST FULL PAPER**

 **Email:** [info@parj.africa](mailto:info@parj.africa)

Request your copy of the full paper today!

## **SUBMIT YOUR RESEARCH**

**Are you a researcher in Africa? We  
welcome your submissions!**

Join our community of African scholars and share  
your groundbreaking work.

 **Submit at:** [app.parj.africa](http://app.parj.africa)



Scan to visit [app.parj.africa](http://app.parj.africa)

### **Open Access Scholarship from PARJ**

Empowering African Research | Advancing Global  
Knowledge