CASE STUDY

Optimizing Pipeline Protection: How Different Abrasives Impact Coating Performance

Abstract and Introduction

Surface preparation is a critical factor in ensuring the long-term performance of pipeline coatings, particularly in corrosive environments. The type of abrasive material used during surface preparation can significantly influence the adhesion, durability, and overall effectiveness of liquid-applied epoxy coatings. This paper presents an in-depth investigation into the performance variations of these coatings when applied to surfaces prepared with different abrasives, including GMA ToughBlast (GX2), steel grit, steel shot, glass grit, and coal slag.

The study evaluates these abrasives based on their impact on two key performance indicators: cathodic disbondment (CD) and hot water immersion (HWI) resistance. Cathodic disbondment testing measures the degree to which a coating disbonds from the substrate when subjected to a cathodic protection current, while HWI testing assesses the coating's resistance to blistering and degradation in hot, moist environments. The results reveal significant differences in performance among the abrasives, with GMA ToughBlast demonstrating superior adhesion and resistance to disbondment, positioning it as a reliable choice for corrosion engineers seeking to optimize pipeline protection.

1. Methodology

1.1 Surface Preparation and Abrasives

The study involved preparing pipeline substrates using a variety of abrasives, including:

- GMA ToughBlast (GX2)
- Steel Grit (LG40)
- Steel Shot (S280)
- Glass Grit (10/30 and 12/20)
- Coal Slag (16/40, 16/30, 12/40, and 20/40)

These abrasives were selected for their widespread use in the industry and their varying physical properties, which are expected to influence coating performance.

1.2 Coating Application

After surface preparation, a liquid-applied epoxy coating was applied to each substrate according to industry standards. The coatings were then subjected to a series of tests to evaluate their performance under simulated service conditions.

1.3 Cathodic Disbondment (CD) Testing

Cathodic disbondment testing was conducted in accordance with the CSA Z245.30-7 standard. Each coated substrate was exposed to a cathodic protection current at 65°C for 28 days. The diameter of the disbonded area was measured to assess the coating's resistance to disbondment.

1.4 Hot Water Immersion (HWI) Testing

The Hot Water Immersion test was performed at both 65°C and 75°C for 28 days. Coated substrates were immersed in hot water, and the coatings were evaluated for blistering and other signs of degradation. Ratings were assigned based on the extent of blistering observed.

2. Results

2.1 Cathodic Disbondment (CD) Results

The CD test results are detailed in Table 1 and illustrated in Figure 1. GMA ToughBlast (GX2) demonstrated a CD diameter of 7.4 mm with a standard deviation of 0.8 mm, indicating strong adhesion and resistance to disbondment. Steel grit (6.3 mm) also performed well, while glass grit and coal slag showed significantly larger disbondment areas, exceeding the maximum allowable CD radius stipulated by the CSA standard.

Table 1: Cathodic Disbondment (CD) Results

Abrasive	CD Diameter (mm)	Standard Deviation (mm)
Steel Shot (S280)	8.1	0.7
Steel Grit (LG40)	6.3	0.4
Recycled Steel Grit (LG40)	8.3	1.1
Glass Grit-1 (10/30)	36.5	2.0
Glass Grit-2 (12/20)	35.6	2.0
GMA ToughBlast (GX2)	7.4	0.8
Coal Slag-1 (16/40)	13.3	1.5
Coal Slag-2 (16/30)	12.7	0.5
Coal Slag-2 (12/40)	14.3	1.1
Coal Slag-3 (20/40)	11.8	0.5
Coal Slag-3 (12/40)	12.2	0.3

Figure 1a: Representative photos to show the disbondment variation of Coating on blasted surfaces

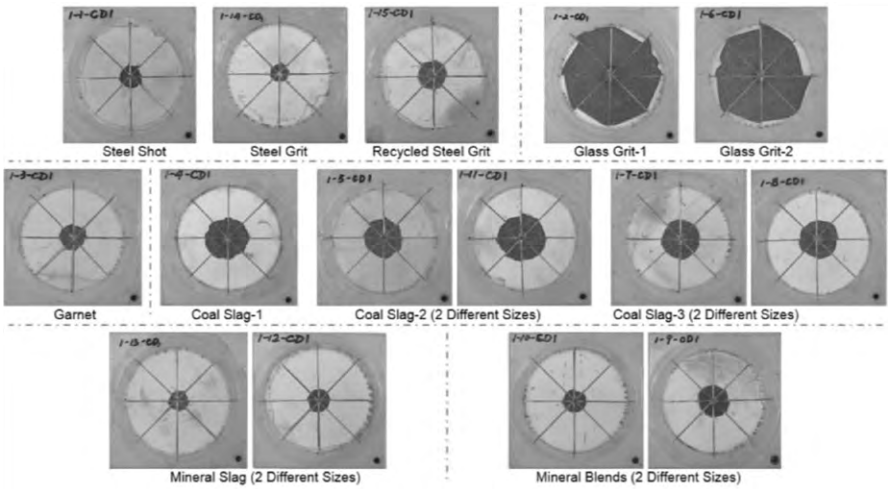
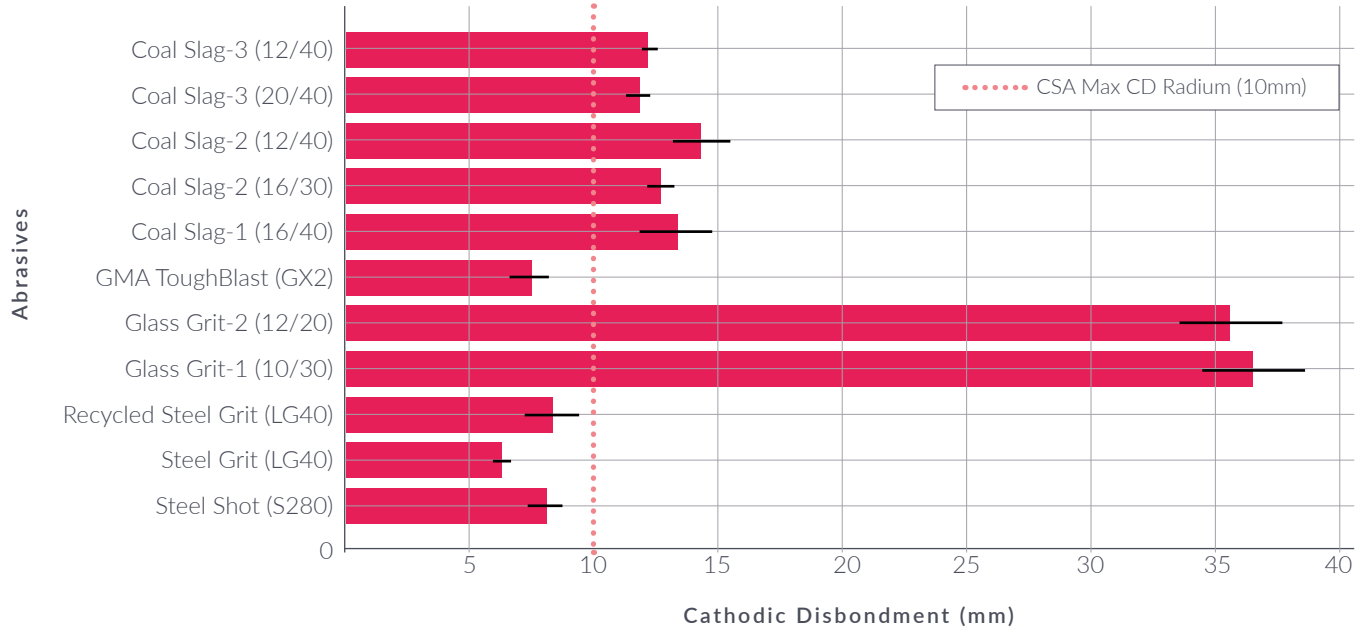


Figure 1b: Cathodic Disbondment (CD) Performance of Various Abrasives



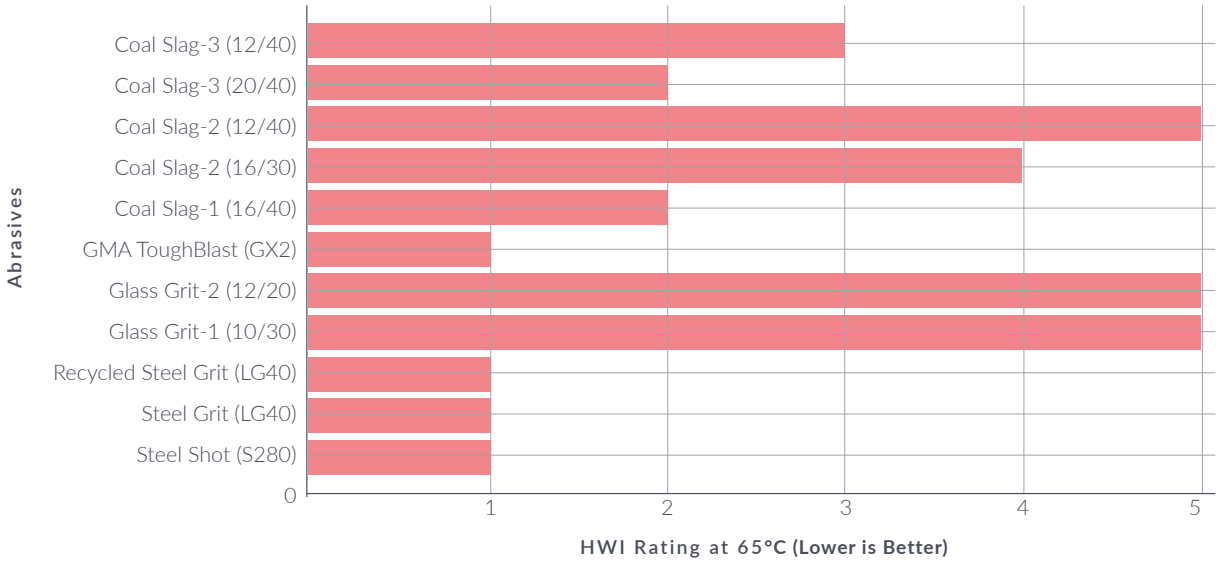
2.2 Hot Water Immersion (HWI) Results

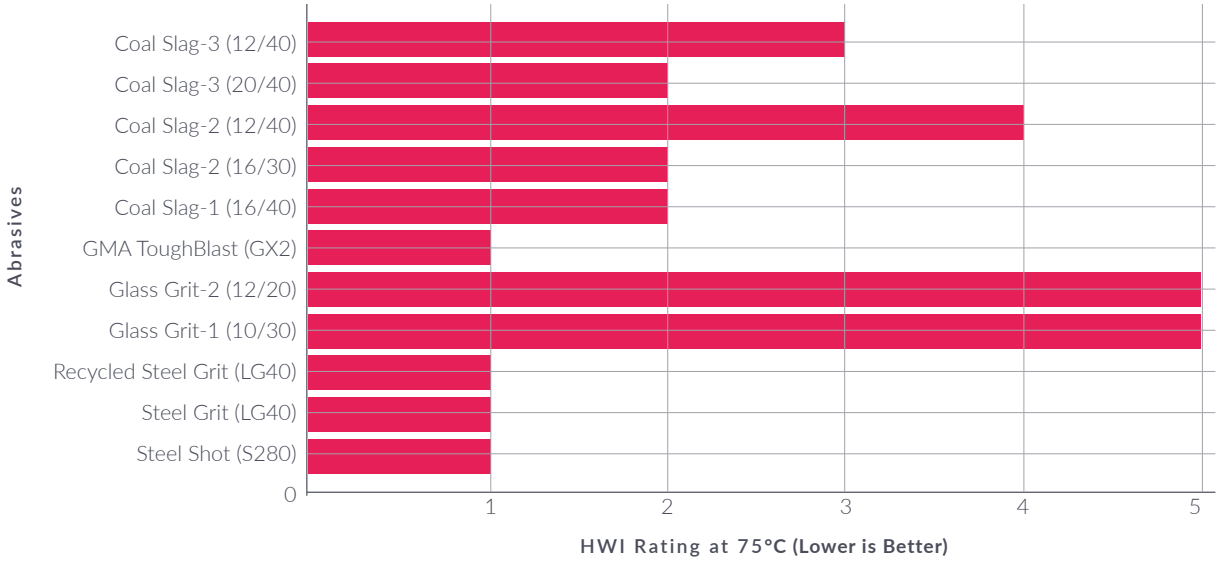
The HWI test results at 65°C and 75°C are provided in Table 2 and Figures 2 and 3. GMA ToughBlast (GX2) achieved a Rating 1 at both temperature levels, indicating no blistering and high coating integrity. Steel grit and shot also performed well, while glass grit and coal slag showed significant blistering, leading to lower ratings.

Table 2: Hot Water Immersion (HWI) Ratings

Abrasive	HWI Rating 65°C	HWI Rating 75°C
Steel Shot (S280)	1	1
Steel Grit (LG40)	1	1
Recycled Steel Grit (LG40)	1	1
Glass Grit-1 (10/30)	5	5
Glass Grit-2 (12/20)	5	5
GMA ToughBlast (GX2)	1	1
Coal Slag-1 (16/40)	2	2
Coal Slag-2 (16/30)	4	2
Coal Slag-2 (12/40)	5	4
Coal Slag-3 (20/40)	2	2
Coal Slag-3 (12/40)	3	3

Figure 2: Hot Water Immersion (HWI) Ratings at 65°C and 75°C





3. Discussion

The results from the CD and HWI tests indicate that GMA ToughBlast (GX2) performs exceptionally well in maintaining coating adhesion and resisting moisture-induced degradation. The slightly higher CD value of 7.4 mm for GMA ToughBlast compared to steel grit (6.3 mm) is within acceptable limits, suggesting that GMA ToughBlast is a viable alternative to traditional steel abrasives.

In contrast, glass grit and coal slag abrasives resulted in significantly larger CD values and greater blistering in HWI tests, indicating potential inadequacies in providing long-term protection for pipeline coatings.

4. Conclusion

This study provides a comprehensive evaluation of the performance of different abrasives in surface preparation for liquid-applied pipeline coatings. GMA ToughBlast (GX2) emerged as a top-performing abrasive, demonstrating superior resistance to cathodic disbondment and excellent performance in hot water immersion tests. These findings suggest that GMA ToughBlast is a highly reliable abrasive for corrosion engineers seeking to optimise coating durability and extend the service life of pipeline infrastructure.

References

Rao, S. (2023). *An In-Depth Investigation into the Causes of the Performance Variations of Liquid-Applied Pipeline Coatings on Different Types of Abrasives Prepared Surfaces.* In AMPP Annual Conference + Expo (pp. AMPP-2023-19561).