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Paper

INFLUENCE OF DE-PAINTING METHOD ON SUBSTRATE SURFACE PROFILE

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ABSTRACT

In this paper, the authors investigated the influence of decoating method on the substrate original surface profile (formed during primary grit blasting). Some experiments were performed on painted low carbon steel samples and; subsequently, the influence of paint stripping with the waterjet and grit blasting on the substrate surface profile was studied. The surface roughness measurement results showed that after paint stripping by the waterjet, the samples surface has an acceptable roughness for recoating. Secondary grit blasting, however, decreased the roughness of the substrate. Furthermore, three dimensional topography images, after decoating process, showed that surface original profile was not compromised by waterjet compared to the deterioration made in secondary gritblasting.

1. INTRODUCTION

In recent years removal of coatings has been a major concern worldwide. Over a period of time, the protective coatings lose their effectiveness and need to be removed. So, several types of techniques have been used to remove undesirable coatings from the substrates. Some conventional methods such as chemical stripping and grit blasting have been used widely for de-coating process. These methods are too costly and becoming restricted by environmental rules. Therefore, a great deal of attention has been paid to various advanced techniques. Among new methods, high pressure water jet technology has gained significant progress during recent years in surface preparation industry. Some of the benefits associated with water jetting are: no grit residues, less health problems, lower disposal costs and improved surface cleanness of the substrate [1]. Above importance of cost and health issues, proper surface preparation is the most critical element to the success of any coating project. According to ISO 8502 (1995) "The performance of protective coatings of paint and related products applied to steel is significantly affected by the state of the steel surface immediately prior to painting". One of the principal factors to influence this performance is the surface profile [2]. Studies show that adhesion of a coating is improved by increasing the substrate surface roughness [3]. Grit blasting has been widely used in surface preparation industry because it has the capability to create a profile at the surface which guarantees a physical bond between the substrate and applied coating system [4]. Furthermore, it is used as a tool for the removal of deteriorated coatings from surfaces. Studies have shown that grit blasting is capable of removing coatings, but it always removes substrate material as well [4]. Therefore, any coating removal process that involves grit blasting is accompanied by substrate damage. The objective of this paper is to investigate and discuss the influence of decoating method on the substrate surface profile generated after paint stripping by waterjet and grit blasting.

2. EXPERIMENTAL SETUP

All tests were run on painted low-carbon steel. Nine specimens were cut away from a standard plate with dimension of 150 mm× 150 mm× 5 mm. Grit blasting of samples were performed by a commercial blasting unit with air pressure of 5 bar and nozzle diameter of 8 mm. Copper slag with a mean particle size of 1 mm was used as the blasting grit. Specimens were kept together and blasted at an exposure time of 100 s, at an angle of 90° and with a stand-off distance between nozzle exit and specimen surface of 200 mm. Three samples were reserved for evaluation of the primary gritblasting and six samples were painted at the following condition. All specimens were cleaned with dry compressed air to remove any rust, grease, or dust from the surfaces to be evaluated. Then, Zinc Rich Epoxy primer was applied to samples with approximate thickness of 60 µm. The thickness of paint was measured with a coating thickness gauge, Electromatic, CECK-LINE 2000 series. Also two layers of Epoxy Polyamide and one layer of Aliphatic Polyurethane paint were applied on samples with a thickness of about 80 µm for each layer. For investigating the influence of paint stripping with the waterjet and gritblasting on the substrate surface profile, three specimens were stripped by waterjet and three of them were stripped by gritblasting. Test condition of the secondary gritblasting was the same as the primary gritblasting

with exposure time of 40s. For controlling and adjusting the stand-off distance and nozzle traverse rate, a mechanism was made with use of a cross-table, an electro-gearbox and an inverter. The waterjet stripping experiments were carried out by using a WOMA Z-225 high pressure system. Paint stripping with the waterjet was performed on the following condition:

- Pressure: 1000 bar
- Stand-off distance: 90 mm
- Traverse rate: 1 mm/s
- Nozzle Type: Fanjet
- Nozzle diameter: 1.5 mm
- Impact angle: 90°

For surface profile examinations, a mechanical profilometer type Taylor Hobson with a cut-off length of 0.8 mm was used. The traverse length of the measured profile was 40 mm and the roughness of each specimen was measured at three different locations. The following roughness parameters were measured: average roughness (R_a), maximum roughness (R_t) and average maximum roughness (R_z). Topography images were taken by submicron form and roughness tester type Talysurf CCI-2000 with precision of 1A.

3. RESULTS AND DISCUSSION

The results of the roughness measurements in different cases are listed in table 1 and 2. Also one surface roughness profile for each condition is shown in Fig 1, 2 and 3. The corresponding relative roughness values are plotted in Figure 4 and 5; all surface roughness parameter results obtained for condition (0) were taken to 100%. Also topography images of substrate surface are shown in Figure 6, 7, and 8. It can be seen that primary grit blasting increased any roughness parameter, whereas the secondary grit blasting has decreased the substrate surface roughness. This, in turn, the second grit blasting affects on the properties of the original substrate surface that had formed during primary grit blasting. Reason of this phenomenon is not completely clear. However the flat regions that are seen in fig. 7 can be used to describe this matter. This image shows that the secondary gritblasting deteriorated the original profile of the substrate, and the made erosion in secondary gritblasting to be the cause of higher number of flat regions. By comparison the surface roughness results and topography images, it could be seen that the paint stripping with the waterjet does not affect on the substrate surface original profile formed during primary gritblasting. Wheras paint stripping with the gritblasting, deteriorate the substrate original surface profile. This means that the adhesion of subsequent coating systems, are deteriorated due to overblasting effect.

4. CONCLUSIONS

A series of tests were conducted to study the effect of paint stripping method on the substrate surface roughness. Conclusions from these results are:

- High speed waterjetting is a safe and environmentally method for paint stripping in comparison to other methods, e.g. solvent stripping and gritblasting.

- It is observed that in paint stripping process; waterjet does not decrease the roughness of substrate surface with compared to the decrease made in secondary gritblasting (overblasting).

- Surface topography images show that paint stripping with the waterjet does not affect on substrate surface original profile.

5. AKNOWLEDGMENTS

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6. REFERENCES

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[3] Schweitzer, Philip A., P.E. Paint and Coatings: application and corosion resistance. New York: Taylor & Francis Group, 2006.
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Table 1. Experimental results of surface roughness measurements (all units are μm).

Test number	Untreated (0)			Grit blasted (I)		
	R_a	R_z	R_t	R_a	R_z	R_t
1	0.94	5.32	6.66	10.23	54.65	107.4
2	0.83	4.7	5.88	10.4	55.56	109.2
3	0.86	4.87	6.09	10.28	54.92	107.92
4	0.96	5.43	6.8	10.31	55.08	108.24
5	0.91	5.15	6.45	10.22	54.6	107.3
6	0.95	5.38	6.73	10.18	54.38	106.87
7	0.78	4.41	5.53	10.11	54.01	106.14
8	0.88	4.98	6.23	10.3	55.02	108.13
9	0.77	4.36	5.45	10.34	55.24	108.55

Table 2. Surface roughness measurements after paint stripping with the waterjet and secondary gritblasting (all units are μm).

Test number	secondary gritblasting			waterjetting		
	R_a	R_z	R_t	R_a	R_z	R_t
1	8.68	47.66	93.65	____	____	____
2	8.64	47.44	90.71	____	____	____
3	8.6	47.22	92.79	____	____	____
4	____	____	____	10.15	54.22	106.56
5	____	____	____	10.27	54.86	107.82
6	____	____	____	10.36	55.34	108.76

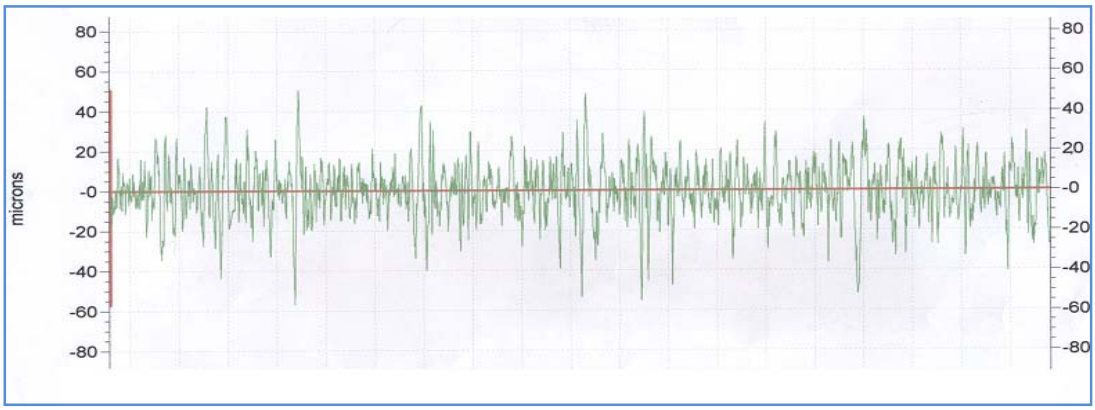

Figure 1. Surface roughness profile after primary grit blasting.

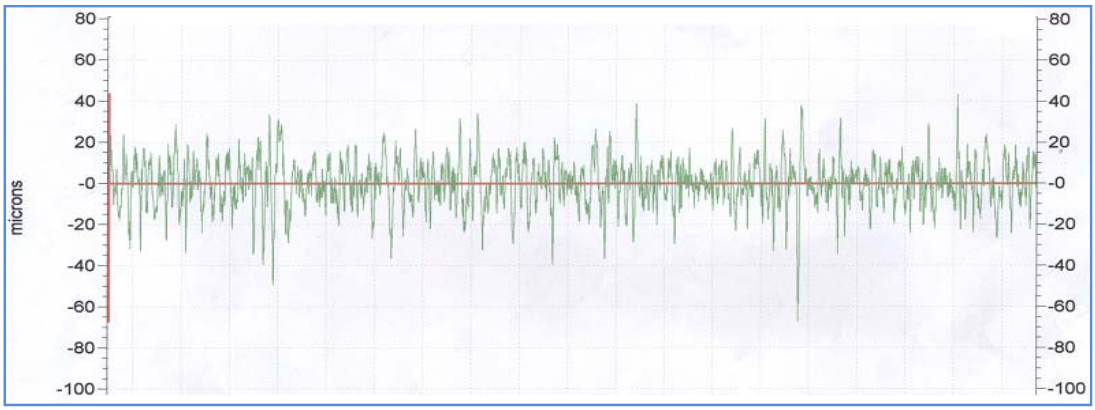

Figure 2. Surface roughness profile after paint stripping by gritblastting (overblasting).

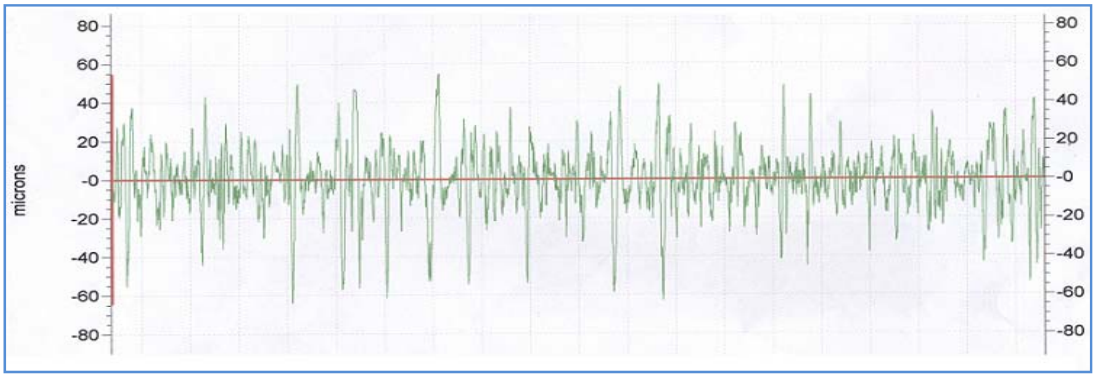

Figure 3. Surface roughness profile after paint stripping by waterjet.

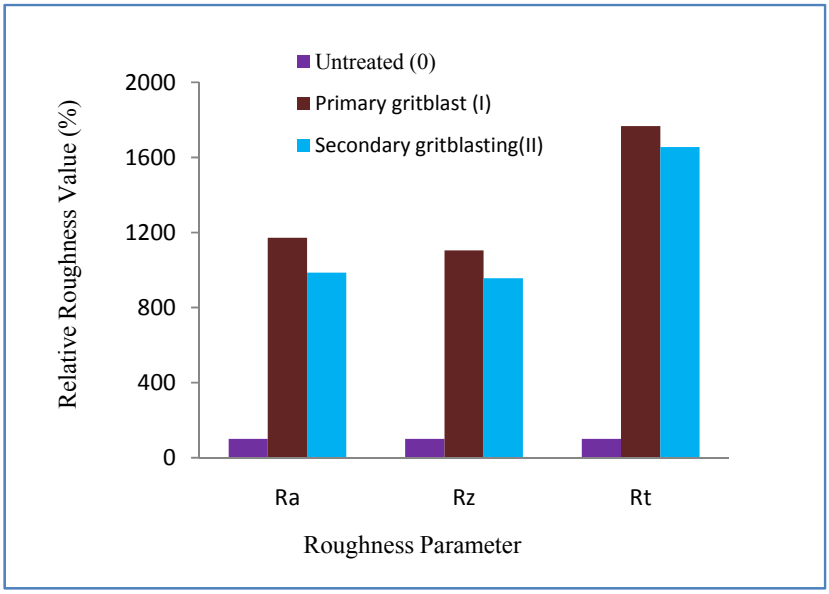

Figure 4. Surface roughness modification due to gritblasting.

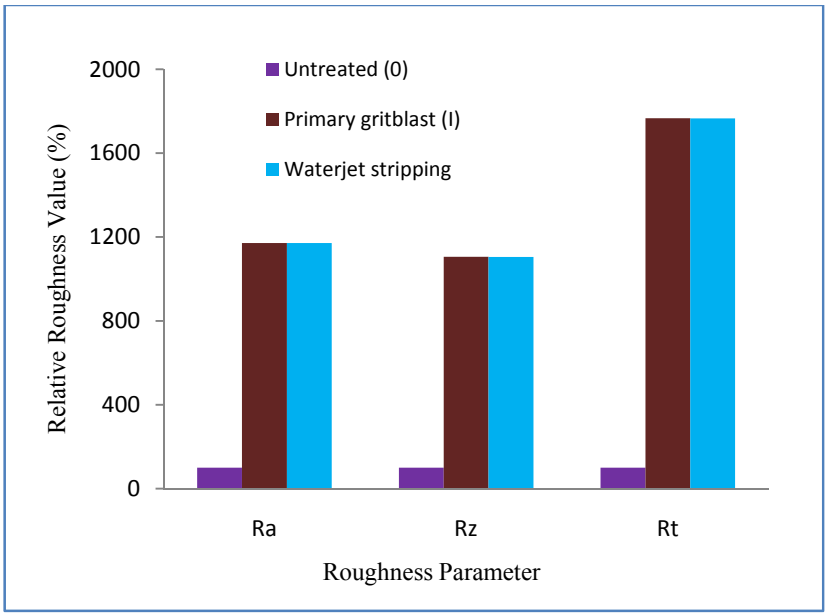

Figure 5. Influence of paint stripping with the waterjet on substrate surface roughness.

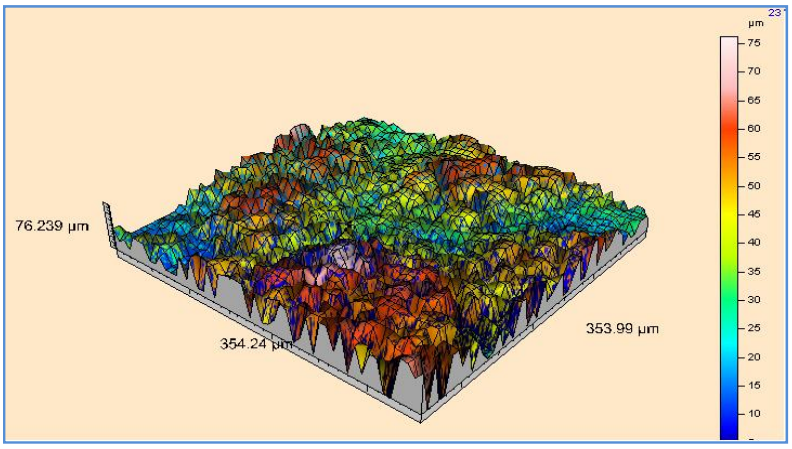

Figure 6. Surface topography after primary gritblasting.

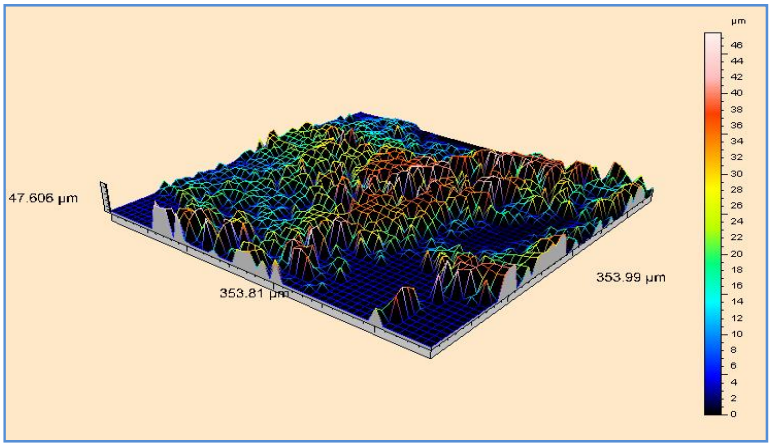

Figure 7. Surface topography after paint stripping by gritblastting (overblasting).

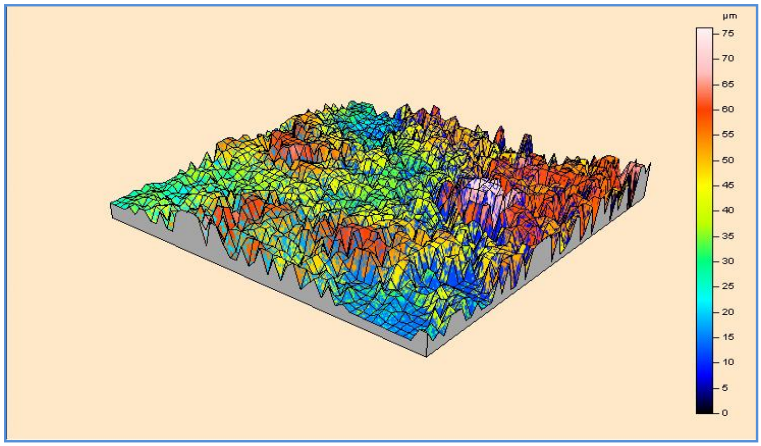

Figure 8. Surface topography after paint stripping by waterjet.