

CHAPTER 2.0

SURFACE PREPARATION

by

H. William Hitzrot

I. INTRODUCTION

It is widely recognized that surface preparation is the most important single factor in coating performance. As our knowledge of the relationship between coating and metal substrate expands, so also does the need for improved and varied surface preparation techniques. This series of chapters represents the current state of the art and covers most aspects of industrial applications of mechanical surface preparation.

Chapter 2.1 Centrifugal Blast Cleaning

Chapter 2.2 Metallic Abrasives

Chapter 2.3 Non-Metallic Abrasives

Chapter 2.4 Abrasive Air Blast Cleaning

Chapter 2.5 Water Blast Cleaning

Chapter 2.6 Hand and Power Tool Cleaning

Chapter 2.7 Field Surface Preparation Costs

Chapter 2.8 Other Methods and Factors in Surface Preparation

Chapter 2.9 Chemical Cleaning in the Field

Pickling is described in a separate chapter.

The chapters were authored by recognized authorities and cover not only the methods of surface preparation but also equipment, types of abrasive, surface preparation cost and some future alternatives. They provide up-to-date information on mechanical surface preparation with a ready reference and background for choosing the proper technique for a given job. For those experienced in the field this material not only reviews techniques but offers possible solutions for some of the out of the ordinary surface preparation jobs as well. Each mechanical method is described in detail together with recommended applications and examples. Also included are types of equipment and anticipated performance criteria.

Both metallic and non-metallic abrasives are discussed. The various abrasives available are described along with recommended applications for these abrasives. Reference is made to a number of specialty abrasive products and their applications.

Surface preparation costs are discussed as a separate section, providing the reader with one means of comparison among the various approaches to mechanical surface preparation.

These chapters cover those methods of surface preparation requiring mechanical force as well as the related equipment, abrasive materials, and costs. Mechanical methods include hand and power tool cleaning, centrifugal wheel blasting, compressed air blasting,

high-pressure water blasting and high-pressure blasting with a mixture of water and sand.

II. DISCUSSION

Mechanical surface preparation has been the traditional approach to preparing metal substrates for subsequent coating systems. Surface preparation methods vary from the most rudimentary hand scraper to laser beams. The broad spectrum of tools available suggests that surface preparation is in fact a complex process and therefore requires a good understanding of the mechanical surface preparation process and job parameters that dictate the process. As an aid in selecting the proper mechanical surface preparation process, the following brief discussion of job parameters and associated techniques is provided.

A. LOCATION OF JOB

Although often not considered, the location of a job is an important parameter in the selection of a surface preparation method. If the job is on a production line, then an automatic operation such as a centrifugal wheel machine should be considered. On the other hand, outside fabrication, maintenance or repair jobs generally call for portable hand and power tools and manual sand blasting. If the job is located in an area where soluble salts could be a surface contaminant, such as near the ocean or in an industrial atmosphere, then wet blast cleaning may be preferable.

B. CONDITION OF SURFACE

The surface preparation method selected will depend on the condition of the surface to be cleaned. For example, is it coated, rusted, painted, or coming directly from the mill? Scaled and rusted surfaces are best cleaned by any of the mechanical methods that employ an abrasive medium. Painted surfaces can be cleaned by hand or with power tools to remove loose paint. For more extensive cleaning of painted surfaces, an abrasive blast cleaning method can be used. Steel coming directly from the mill is usually cleaned by means of production line centrifugal wheel machines.

C. DEGREE OF CLEANLINESS

The required degree of cleanliness as defined by the SSPC Surface Preparation Specification is a determining factor in the method of cleaning. Hand tool and power tool specifications apply only where localized surface prepara-

tion is required, as in the removal of loose paint, loose rust, or other localized surface defects. Blast cleaning specifications usually cover applications where the entire surface is to be prepared to a defined degree of cleanliness.

D. PHYSICAL VERSUS CHEMICAL CLEANLINESS.

Studies by R. Allen¹ and A. McKelvie², confirmed by SSPC³, show that residual chemical contaminants may be a greater threat to a coating system than physical surface imperfections. According to these studies, ordinary abrasive blast cleaning techniques do not remove non-visible contaminants such as salts from a rusted, contaminated surface. Methods such as high-pressure water blasting and high-pressure water-abrasive blast cleaning have proven more effective in removing such surface contaminants. A further discussion of water blasting is given in the subsection dealing with water blast cleaning.

E. PROFILE

The surface finish (or profile) resulting from surface preparation should be compatible with subsequent coating

or finishing steps. If the final coating is two mills or less, the surface finish should be finer than if a heavy coating were required. Ideally, test panels prepared prior to the start of a job offer the best method for testing the adequacy of a chosen surface finish. A report is available from the SSPC on profile, its formation, its measurement, its control, and its effect on coating performance⁴.

Most coating manufacturers recommend a degree of cleanliness and a minimum etch or profile for good coating adhesion. When choosing a mechanical surface preparation method, one should take into consideration the compatibility of the subsequent coating. To aid in selecting the proper abrasive for a given surface profile or etch, Table 1 is provided as a guide.

F. ENVIRONMENTAL CONSTRAINTS

In recent years environmental constraints have played an ever larger role in the selection of surface preparation methods. To minimize dust, cheaper sands are being replaced by costlier and less abundant products such as boiler slags or copper slags. Also, enclosed rather than open blasting is being favored. If enclosed blast cleaning is necessary, consideration should be given to recyclable steel abrasives and automated centrifugal wheel blasting

TABLE 1
Typical Profiles Produced by Some Commercial Abrasive Media

	Maximum U.S. Sieve Size	Typical Profile Height, (mils) Maximum	“Average” Maximum
<u>Steel Abrasives</u>			
Shot S-230	20	2.9 ± 0.2	2.2 ± 0.3
Shot S-280	18	3.5 ± 0.3	2.5 ± 0.4
Shot S-330	16	3.8 ± 0.4	2.8 ± 0.5
Shot S-390	14	4.6 ± 0.5	3.5 ± 0.7
Grit G-50	30	2.2 ± 0.3	1.6 ± 0.3
Grit G-40	20	3.4 ± 0.4	2.4 ± 0.5
Grit G-25	16	4.6 ± 0.5	3.1 ± 0.7
Grit G-14	12	6.5 ± 0.8	5.1 ± 0.9
<u>Mineral & Slag Abrasives</u>			
Heavy Mineral Sand	Medium-Fine	3.5 ± 0.4	2.6 ± 0.4
Flint Shot	Medium-Fine	3.5 ± 0.4	2.7 ± 0.4
Silica Sand	Medium	4.0 ± 0.5	2.9 ± 0.4
Boiler Slag	Medium	4.6 ± 0.5	3.1 ± 0.5
Boiler Slag	Coarse	6.0 ± 0.7	3.7 ± 0.7
Staurolite	Medium-Fine	2.6 ± 0.4	2.2 ± 0.4
Copper Slag (Air-Cooled)	Coarse	6.0 ± .7	5.5 ± .5
Copper Slag (Air-Cooled)	Medium	4.5 ± .5	4.0 ± .5
Copper Slag (Air-Cooled)	Medium-Fine	3.5 ± .5	3.0 ± .5
Copper Slag (Air-Cooled)	Fine	2.5 ± .5	2.0 ± .5