Analysis and research equipment
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APPLICATION NOTE

INDUSTRIAL APPLICATIONS

Surface Carbon On Metal Sheets

Introduction

Concentration of surface carbon on steel directly affects performance of coating process on steel surface. Source of carbon on the surface might be contamination or lubrication during the process of production.[1,2] Carbon on the surface of steel sheets, to be coated by any material like paint, enamels, primers, etc is very critical quality control parameter.[3] Therefore, surface carbon needs to be determined and controlled to achieve successful coating.

The same is applicable from hygiene point of view on aluminum sheet materials to be used in food industry for packaging. Source of carbon on the surface might be the same however control requirement is not for coating but health and safety this time.

It is possible to determine specifically surface carbon concentration on metal sheets by using TRL-SC analyzer. It has patented "Two Zone Furnace" design easily converting carbon into CO_2 for further measurement by an NDIR detector. The same feature also provides extended catalyst service life. Calculated value of CO_2 is converted into carbon concentration per area of the material. It is possible to diffrentiate surface carbon concentration by its nature, total organic carbon and amorphous carbon.

Calibration Sample

Surface carbon calibration samples/standars are not readily avaliable so sucrose solution was used as a calibration material in our experimental studies.

Equipment settings and analysis

Analysis parameters of total organic carbon (TC) and amorphous carbon measurements are in table 1.

Table 1: Analysis Parameters

Parameters	Total Organic Carbon (TOC)	Amorphous Carbon
Method Mode	TC Low Mode	TC low Mode
Sample furnace temperature	450 °C	600 °C
Catalyst furnace temperature	500 °C	500 °C
Carrier gas	Oxygen	Oxygen
Carrier gas pressure	2 bar	2 bar
Total Carrier gas flow	100 mL/min	100 mL/min
Analyzer gas flow	100 mL/min	100 mL/min

Total organic carbon: Sample is inserted in the loading car and it automatically drives the samples into the furnace set at 450 ^{o}C . Combustion/decomposition gas coming through the sample furnace go through the catalyst furnace at 500 °C to further oxidize any incomplete combustion products to CO_2. After conditioning of combustion products, it is analyzed for CO_2 concentration in a NDIR detector.

Amorphous Carbon: After TOC analysis, the same samples were analyzed for its amorphous carbon by setting furnace temperature at 600 ^{o}C.

Results

Table 1: Stainless steel samples analysis result

Sample	TOC (mg/m^2)	Amorphous Carbon(mg/m^2)	Total surface Carbon (mg/m^2)
A	26.36	6.45	32.81
B	19.90	1.99	21.90
C	27.24	7.37	34.62
D	21.50	0.05	21.55

Discussions

TRL-SC with its flexible configuration options for automation is proven to analyze surface carbon parameters like amorphous and total organic carbon on metal surfaces whichs helps assuring quality surface coating process of metal sheets.

References

1. King, Arthur E. “Direct Determination of Carbon on Metal Surfaces.” AFP/SME Technical Paper FC78-584. Dearborn, MI: Association for Finishing Processes / Society of Manufacturing Engineers. 1978.

2. Devries, J. E., Haack, L. P., & Coduti, P. L. (1994). Measurement of Carbon on Cold-Rolled Steel: A Comparative Study Using Surface Analytical and Coulometric Methodologies. Industrial & Engineering Chemistry Research Ind. Eng. Chem. Res., 33(11), 2618-2630. doi:10.1021/ie00035a013

3. Coduti, Phillip L. “Effects of Steel Processing on the surface Carbon of Cold-Rolled Steel.” Technical paper presented at the American Society for Metals / American Deep Drawing Research Group Conference: Technological Impact of Surfaces: Relationship to forming, welding, and painting. April 14, 1981.