

# FERRITE CONTENT DETERMINATION. METHOD VALIDATION FOR USE IN DUPLEX STAINLESS STEELS: TRADITIONAL VERSUS DIGITAL APPROACHES

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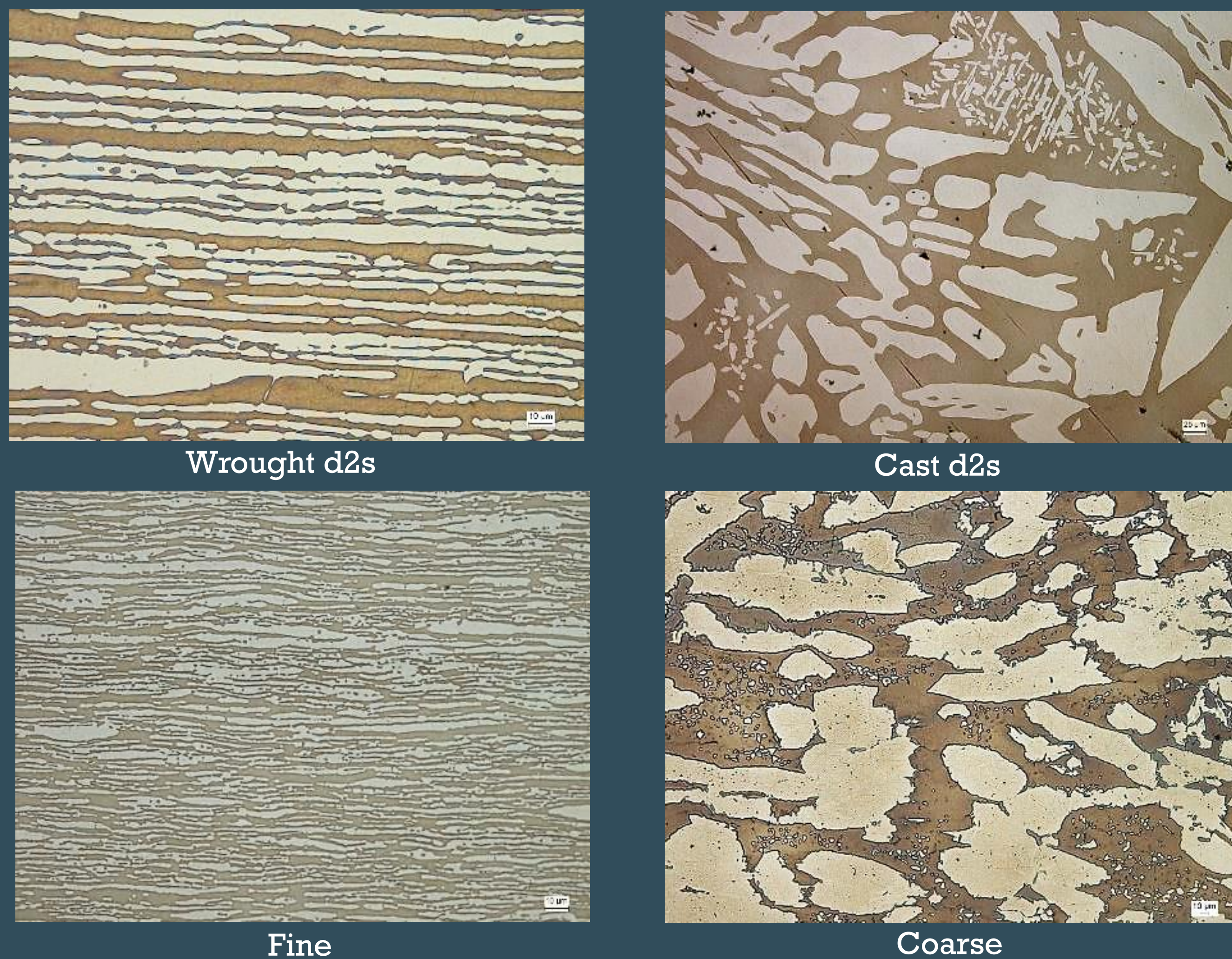
## ABSTRACT

The aim of this work is to validate the Volume Fraction (VF) determination method that is more suitable for industrial use, knowledge creation and transfer. Two duplex stainless steels (d2s) were analysed by two different metallographic approaches (ASTM E562 and ASTM E1245), by varying magnification, grit size and the number of fields used. For the analyses Ferrite content and its variability within techniques due to the analytical variables are discussed. Finally, comparison is made between the final values for the ferrite content determined by each metallographic approach. The results highlight the recommendation for the use of the digital automatic image analysis, over the common traditional manual counting point approach. Since the digital approach allows a more efficient accurate and comprehensive process in terms practical results, simplicity, time and output representativeness of the total volume by considering all image points population counting. Digital automatic image analysis approach can be nowadays be more suitable for good contrast images volume fraction determinations.

## INTRODUCTION

Several methods may be used for determining the ferrite content in d2s, being manual point counting widely used since it is always available at any metallography laboratory. On the other hand, automatic image analysis is an alternative technique that can be also considered for achieving the same type of results, however, requires the existence of special software and digital image acquisition capabilities in order to perform the analysis allied with expertise and trained technicians. This reason lead to the technique practical application not be available for a large number of laboratories. Consequently, manual technique is kept as the conventional specified method for determination of the ferrite VF on d2s steels.

## MATERIALS



Wrought d2s

Cast d2s

Fine

Coarse

## CONCLUSIONS

- Automatic and manual VF determination methods, when performed over the same images, result in similar values for 64% of the analysis;
- Band spacing below 1,5 µm provides a difference between the results obtained by each one of the two techniques;
- Automatic image analysis is a high precision quantitative technique, since it measures all the pixels present on the micrographs;
- Standard deviation is reduced if a higher number of points are considered in the analysis of representative magnified fields;
- Expertise and trained technicians are a key point in reducing error and enhancing the quality of the achieved results.

Material condition	Duplex	Superduplex
Cast	ASTM A995 4A	ASTM A995 5A ASTM A995 6A
Wrought	EN 1.4462	EN 1.4410 SA 790 UNS S32750

## METHODS (MANUAL VS. AUTOMATIC)

ASTM E 562

ASTM E 1245

Grids

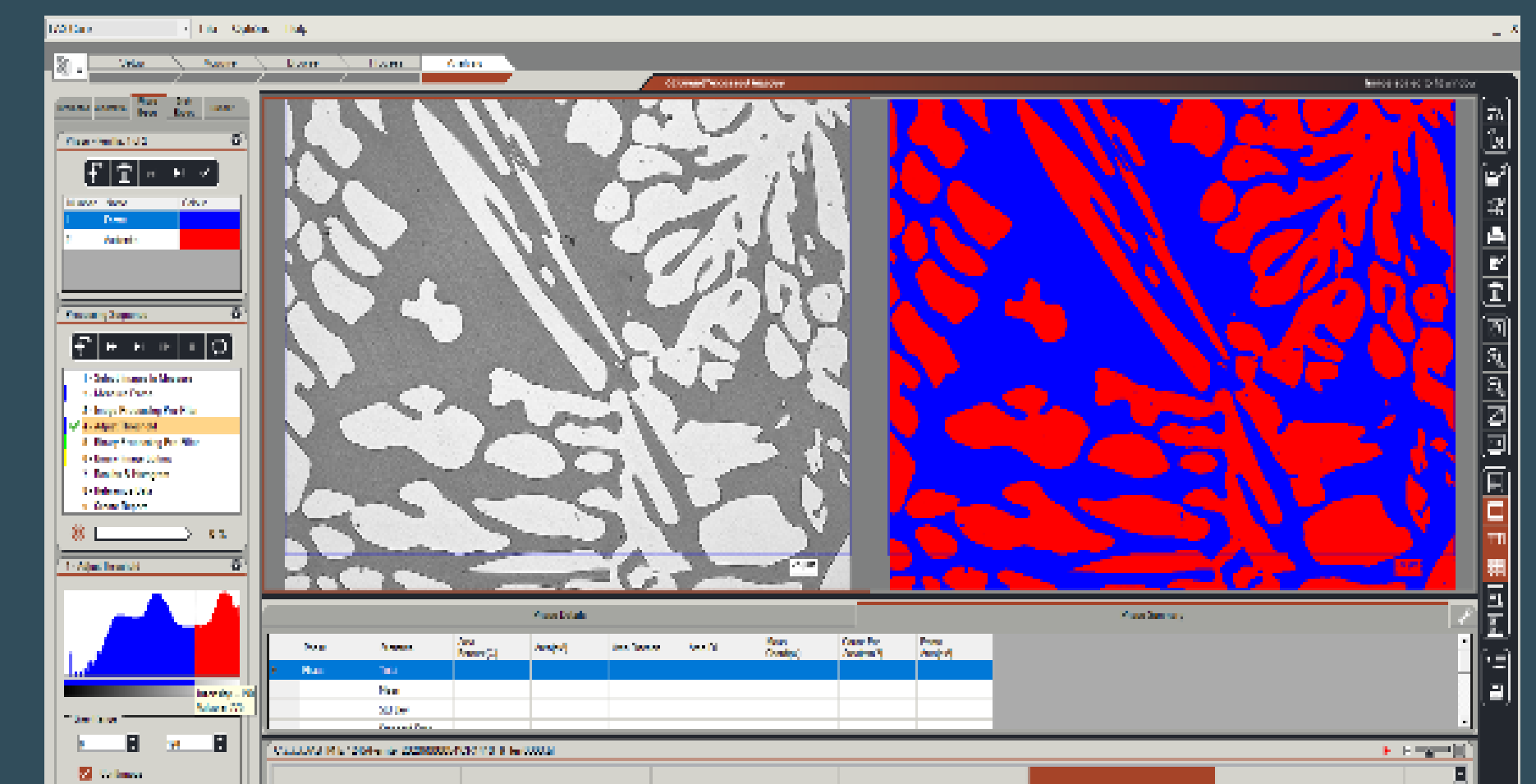
16 and 100 point

Magnification

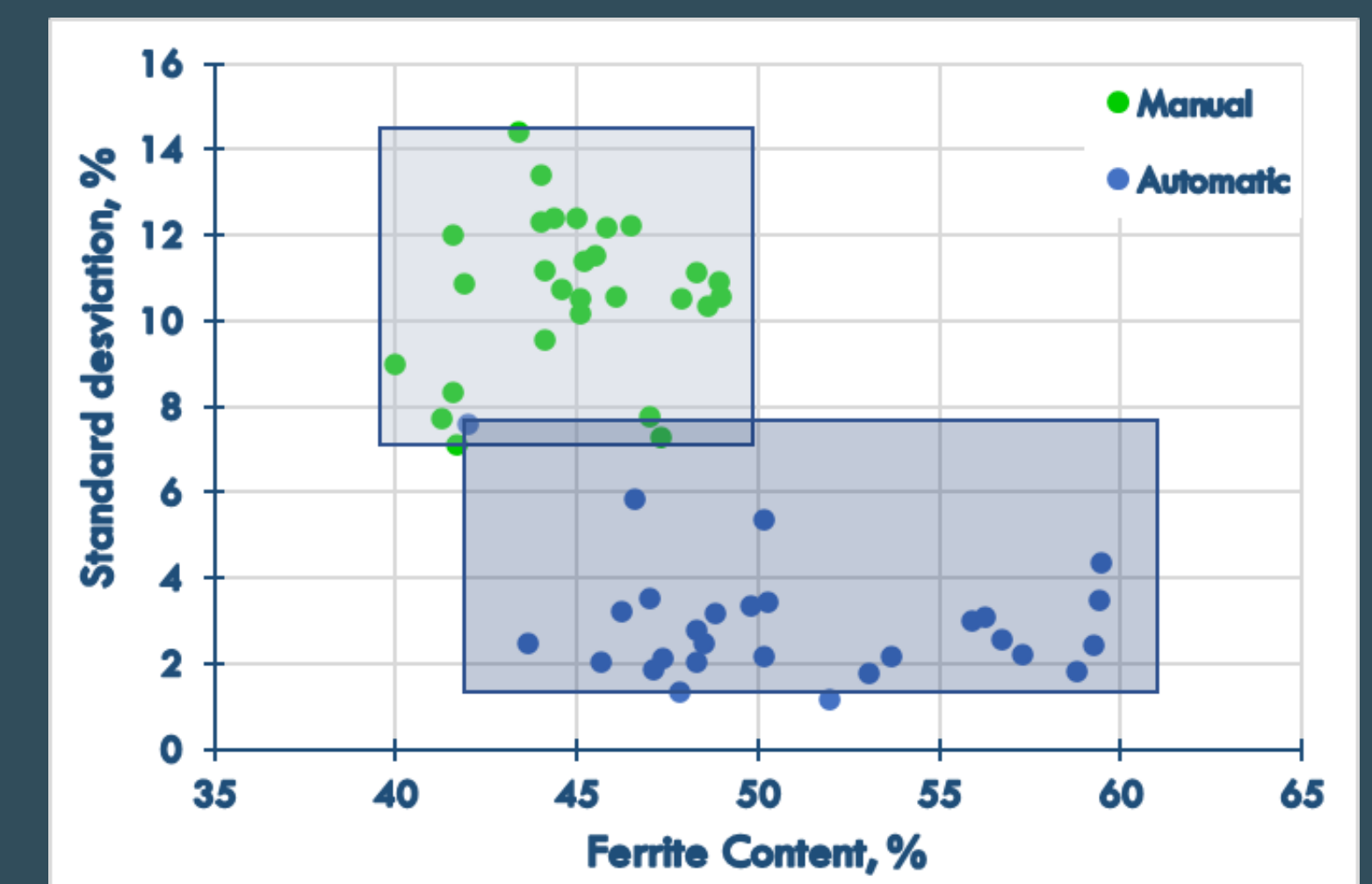
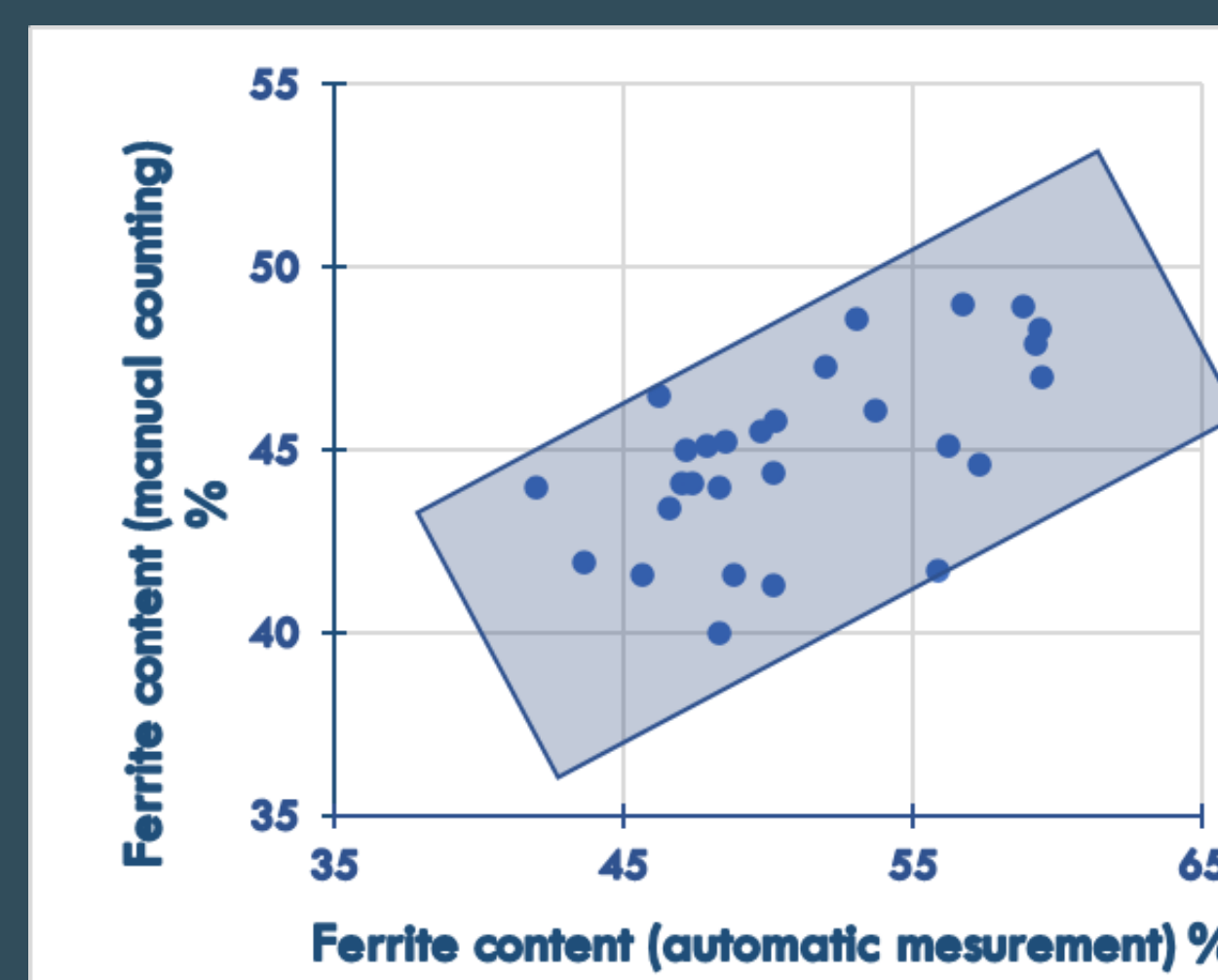
200x and 500x

Etching

NaOH 40% electrolytic



## RESULTS



Results difference	Quantity	Relevance	Cumulative Sum
Acceptable results	14	50%	50%
≥ 4, < 6	2	7%	57%
≥ 6, < 8	3	11%	68%
≥ 8, < 10	3	11%	79%
≥ 10	6	21%	100%

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