



# Optimization of High Purity Compacted CaSi 30/70 in L.C.A.K. steels and cleanliness vs. Conventional CaSi 30/60

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RBC 10/2012

# HPC 30/70 CaSi

## Performance Optimization

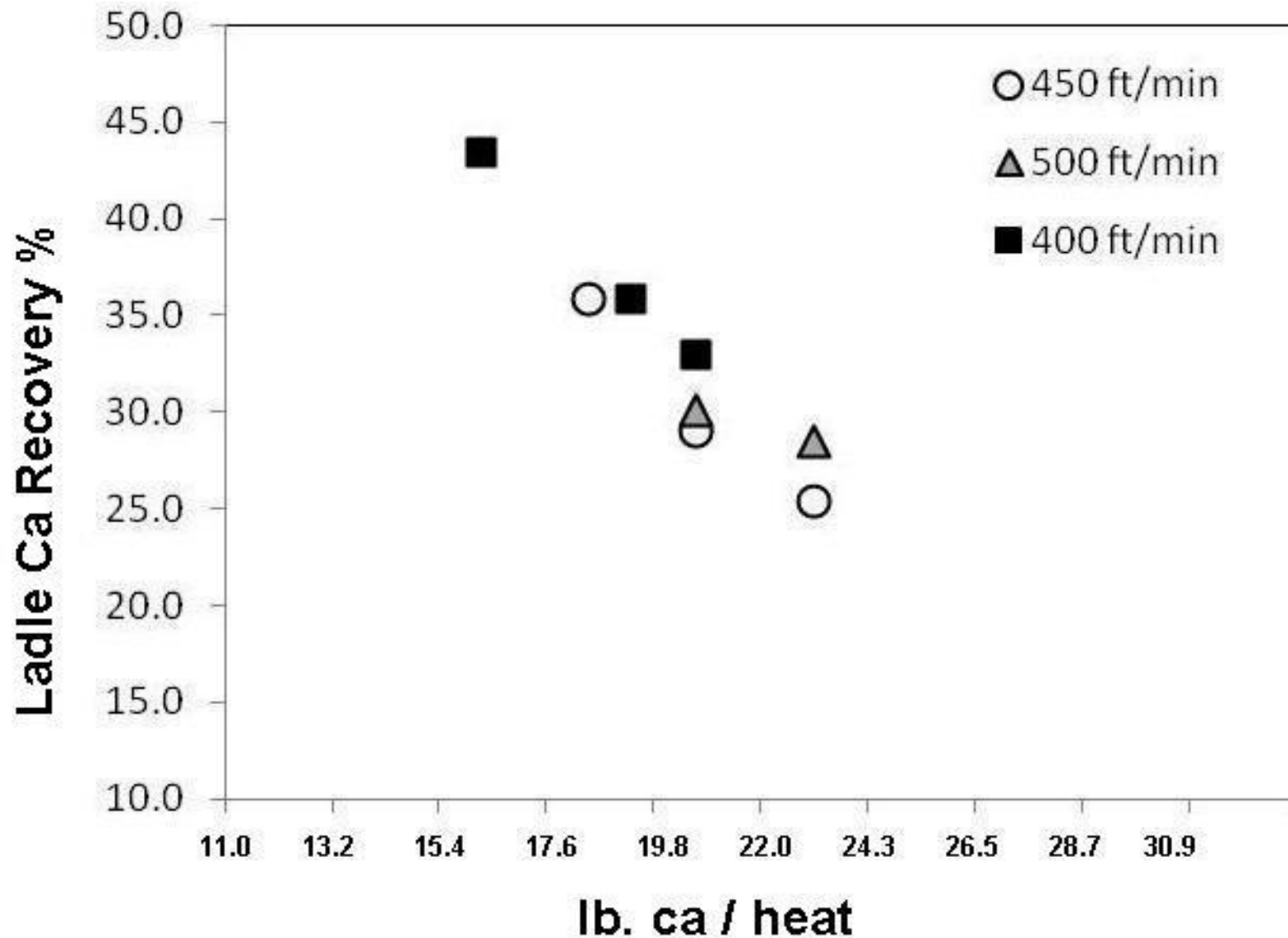


### Average Heat Results

Feet wire Injected	Heat tons	Lb. Ca per heat	Lb. Ca per ton	Average ladle PPM Ca	Average ladle Recovery %	Standard dev
436	167	20.3	0.121	20	33.7	8.1

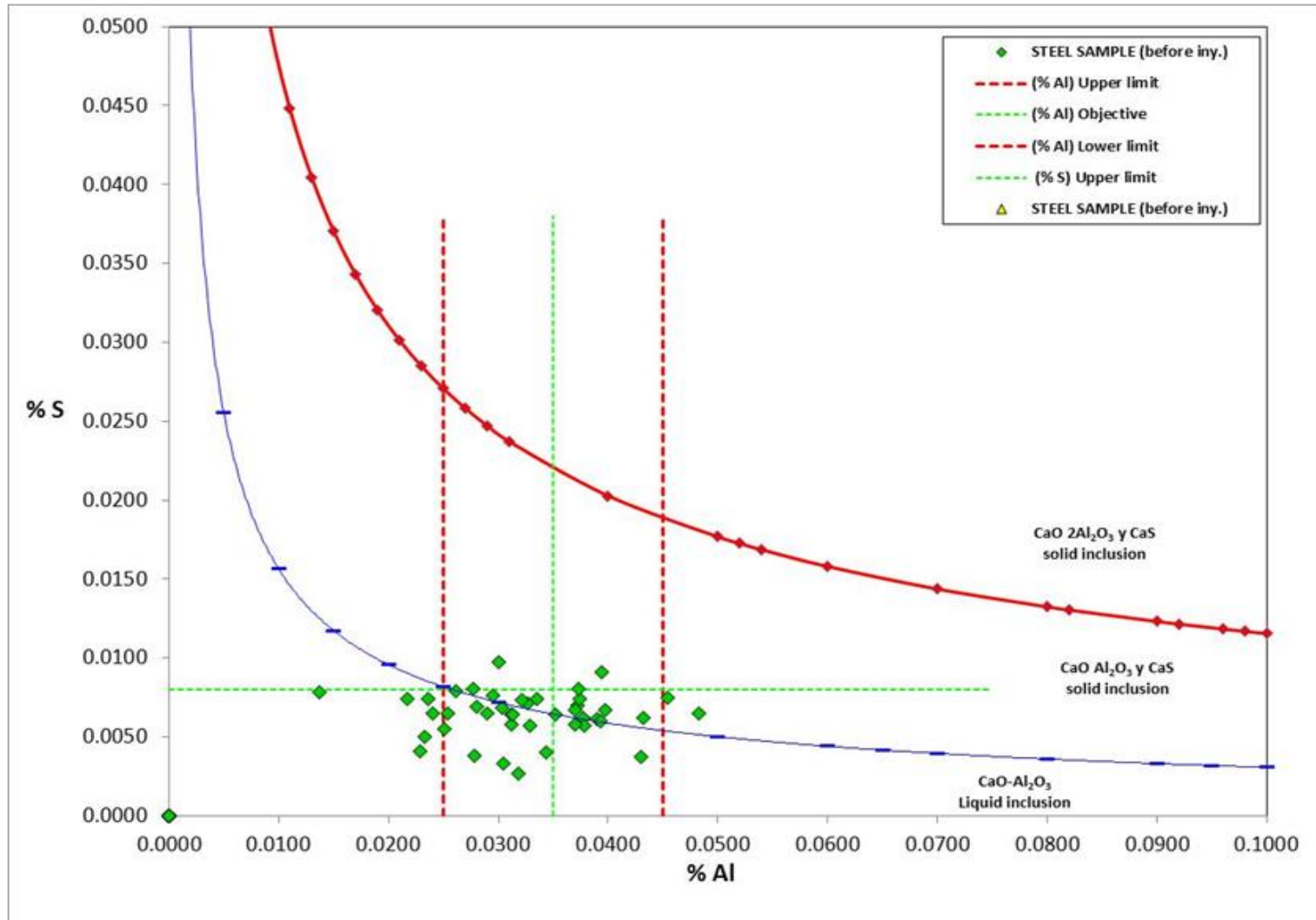
# HPC 30/70 CaSi

## Performance Optimization



# HPC 30/70 CaSi

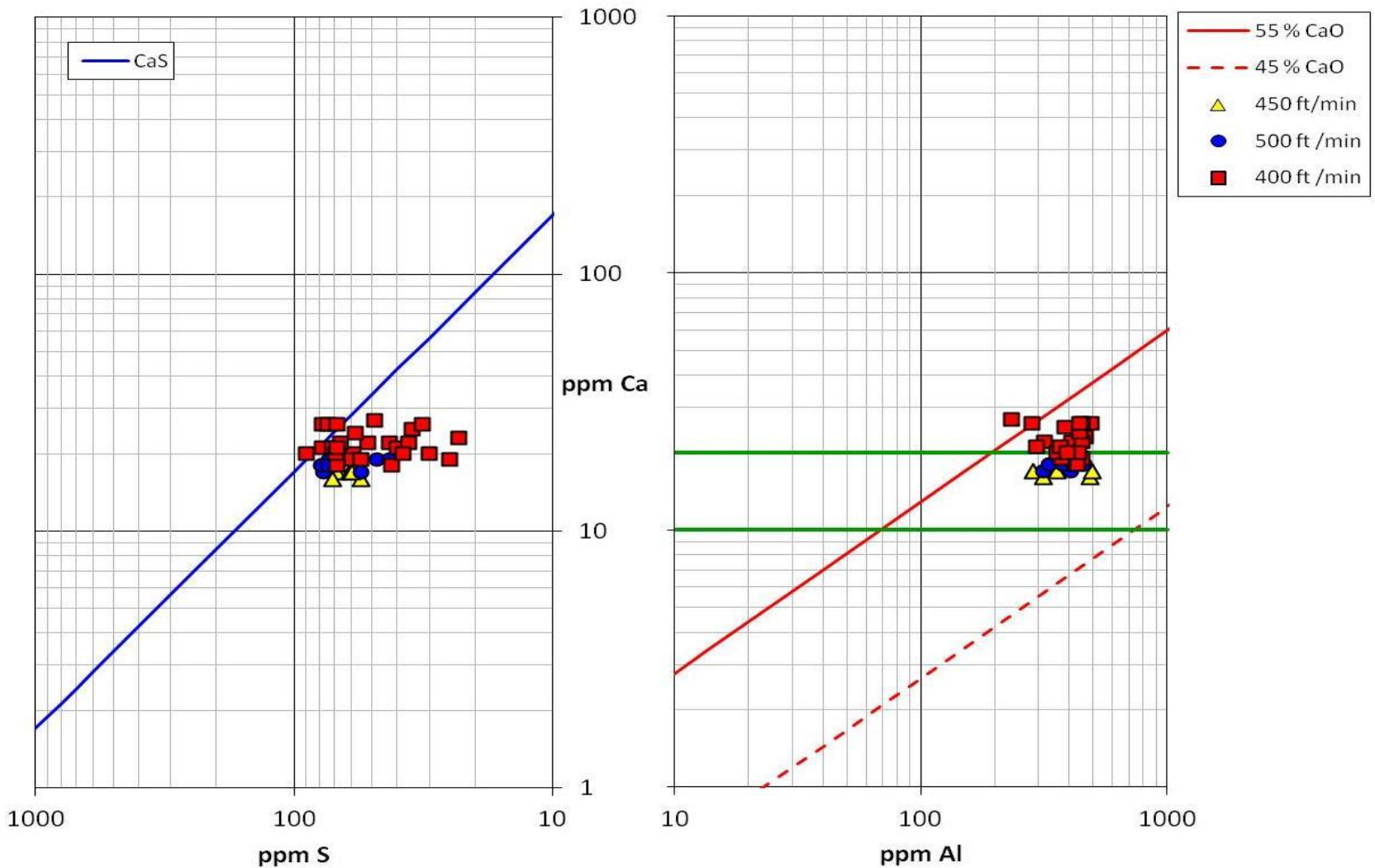
## Performance Optimization





# HPC 30/70 CaSi

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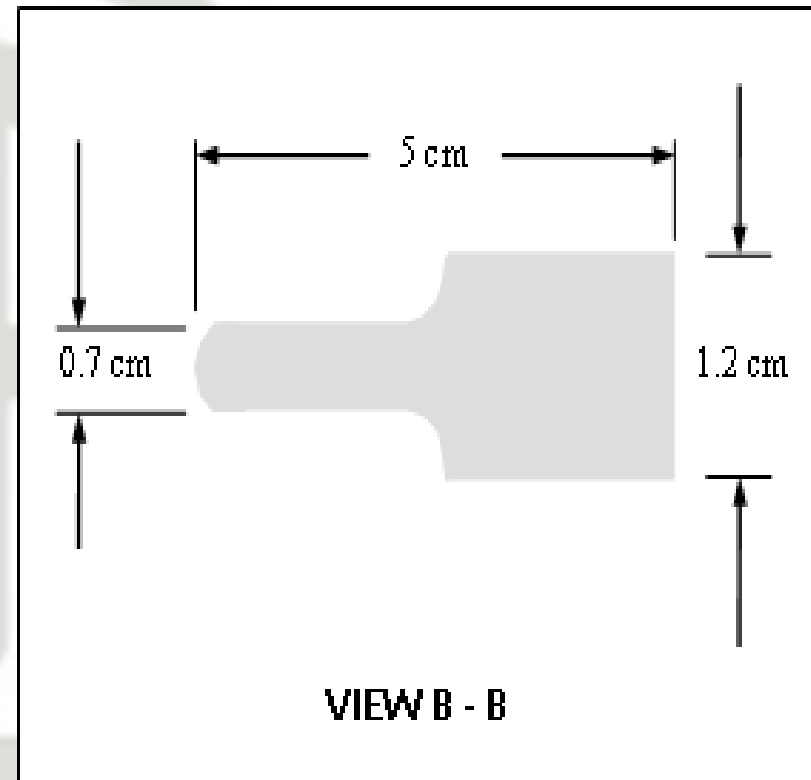
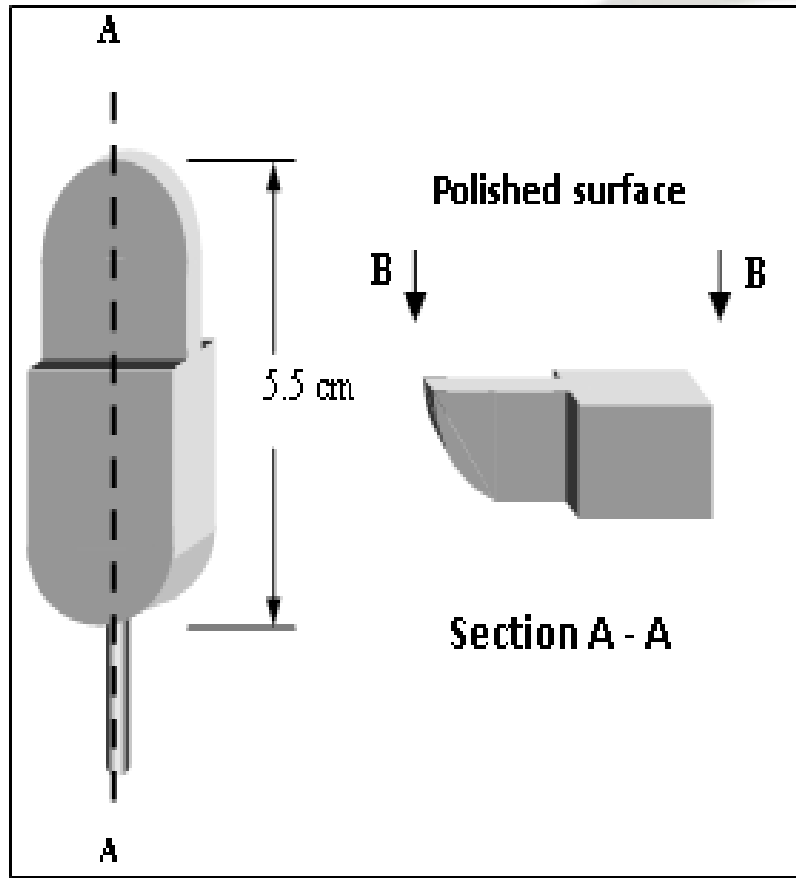
Optimum  
Performance Heat  
Results

Steel Chemistry after  
treatment

Heat	Heat tons	Feet wire	Lb. Ca	wire speed feet/minute	%C	%Si	%S	%Al	%Ca	Ladle Recovery %
A	167	351	16.3	400	0.12	0.184	0.0066	0.045	0.0022	45.4
B	167	351	16.3	400	0.17	0.180	0.0068	0.037	0.0014	28.9
C	167	351	16.3	400	0.17	0.179	0.0073	0.039	0.0020	41.3

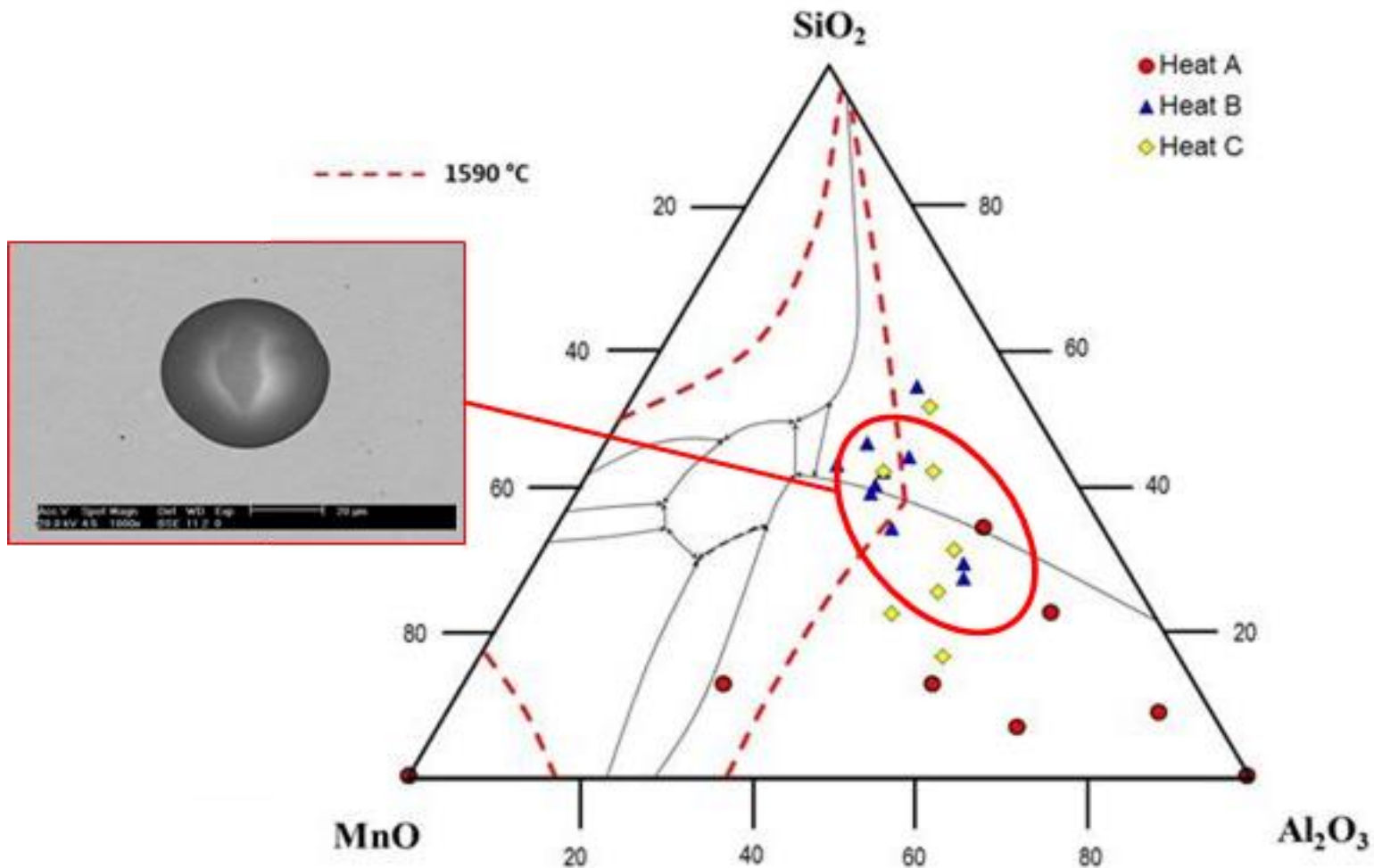


# HPC 30/70 CaSi Inclusion Measurement

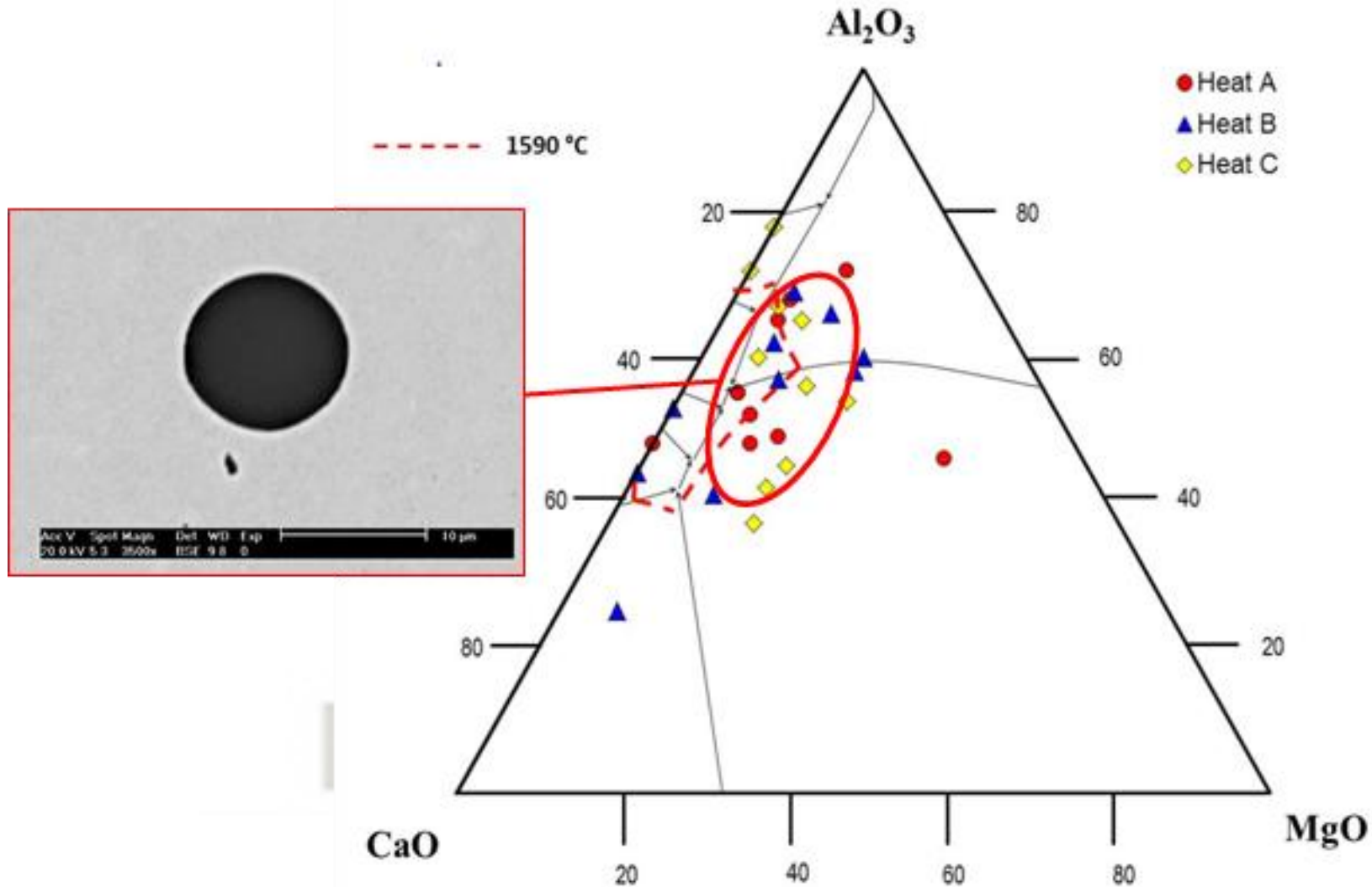




# HPC 30/70 CaSi Inclusion Measurement

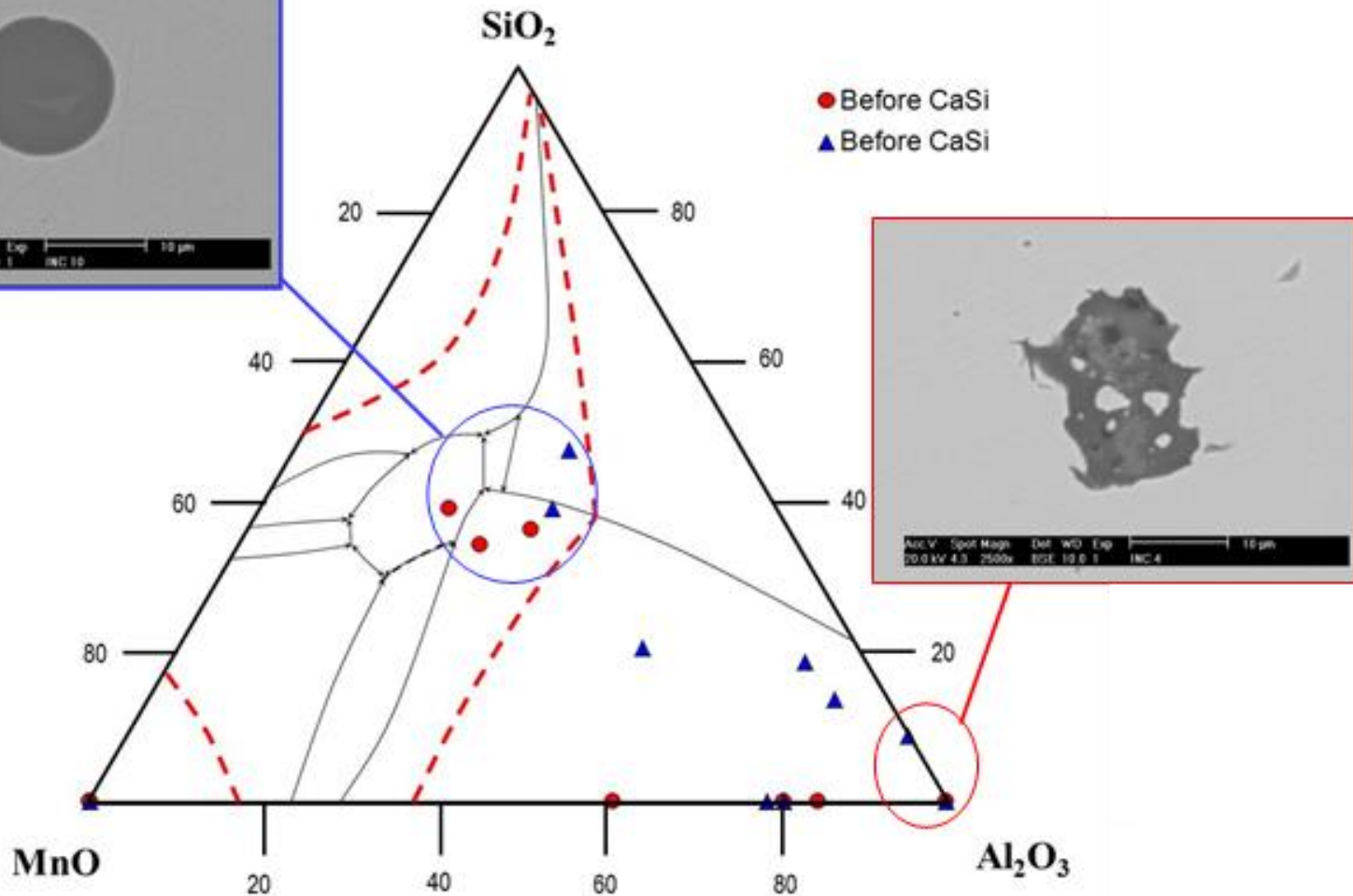
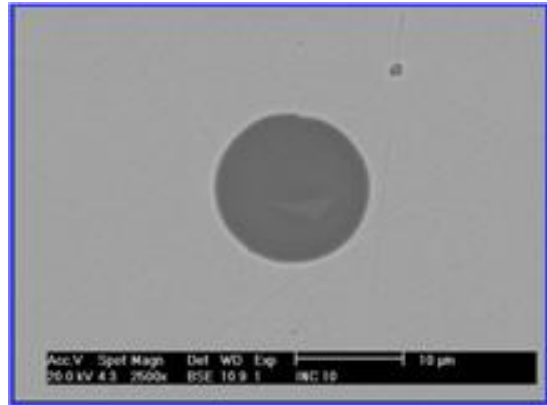


# HPC 30/70 CaSi Inclusion Measurement



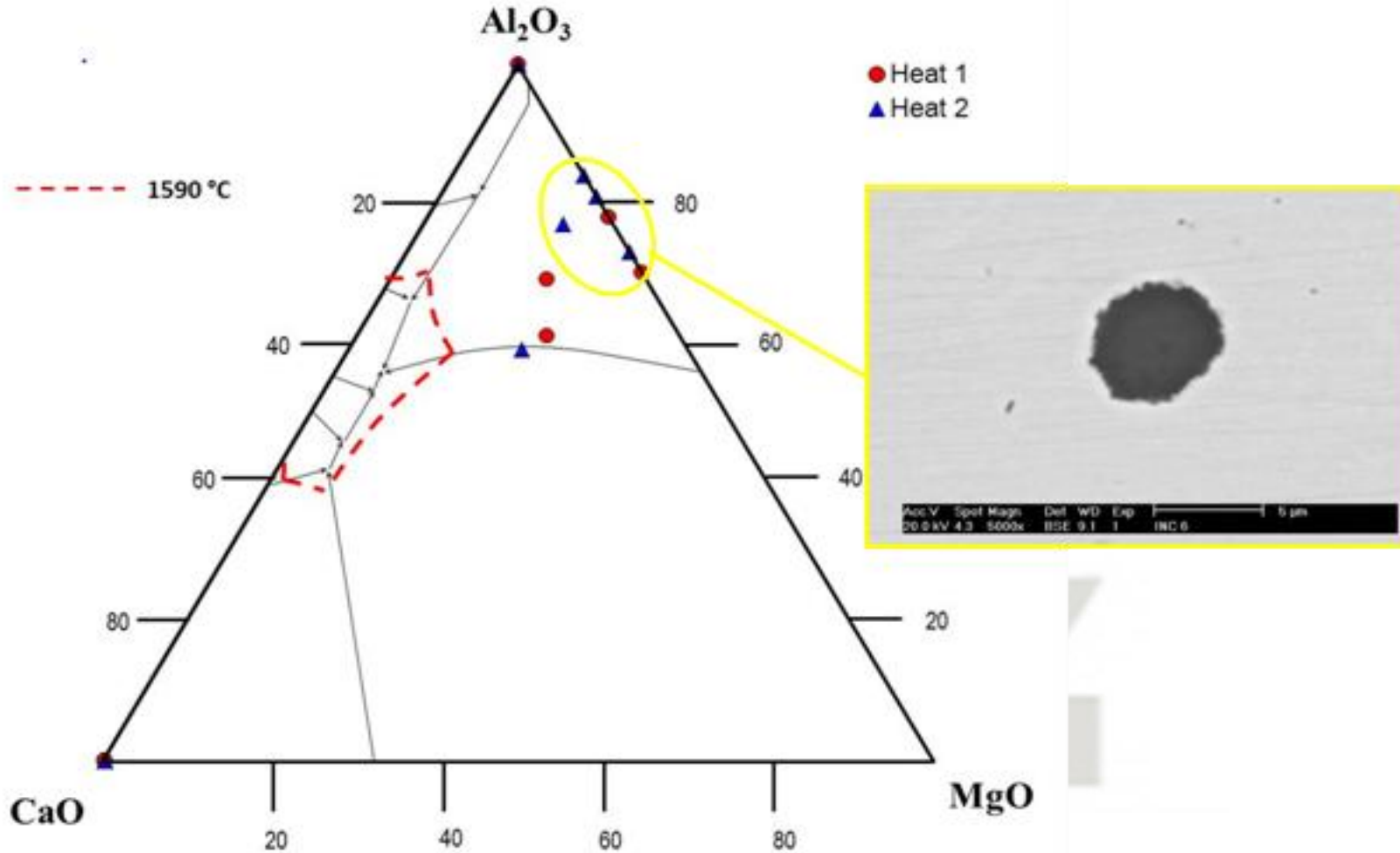
# CCW 30/60 CaSi

## Inclusions before treatment



# CCW 30/60 CaSi

## Inclusions after treatment



# Extreme Value Analysis



A short review:

Yukitaka Murakami: Dr. of Engineering Dept  
Mech. Science and Engineering

Kyushu University Fukuoka Japan

- 1994 Y. Murakami is published in National Institute of Standards and Technology (Gaithersburg Md.)
  - Inclusion rating by S.E.V. and application to Fatigue Strength Prediction and **Quality Control of Materials**
- 2006 Journal of ASTM International
  - Statistical Analysis of Nonmetallic Inclusions for the Estimation of Rolling Contact Fatigue Life and Quality Control of Bearing Steel (Girodin, Dudragne, Courbon, Vincent et al)

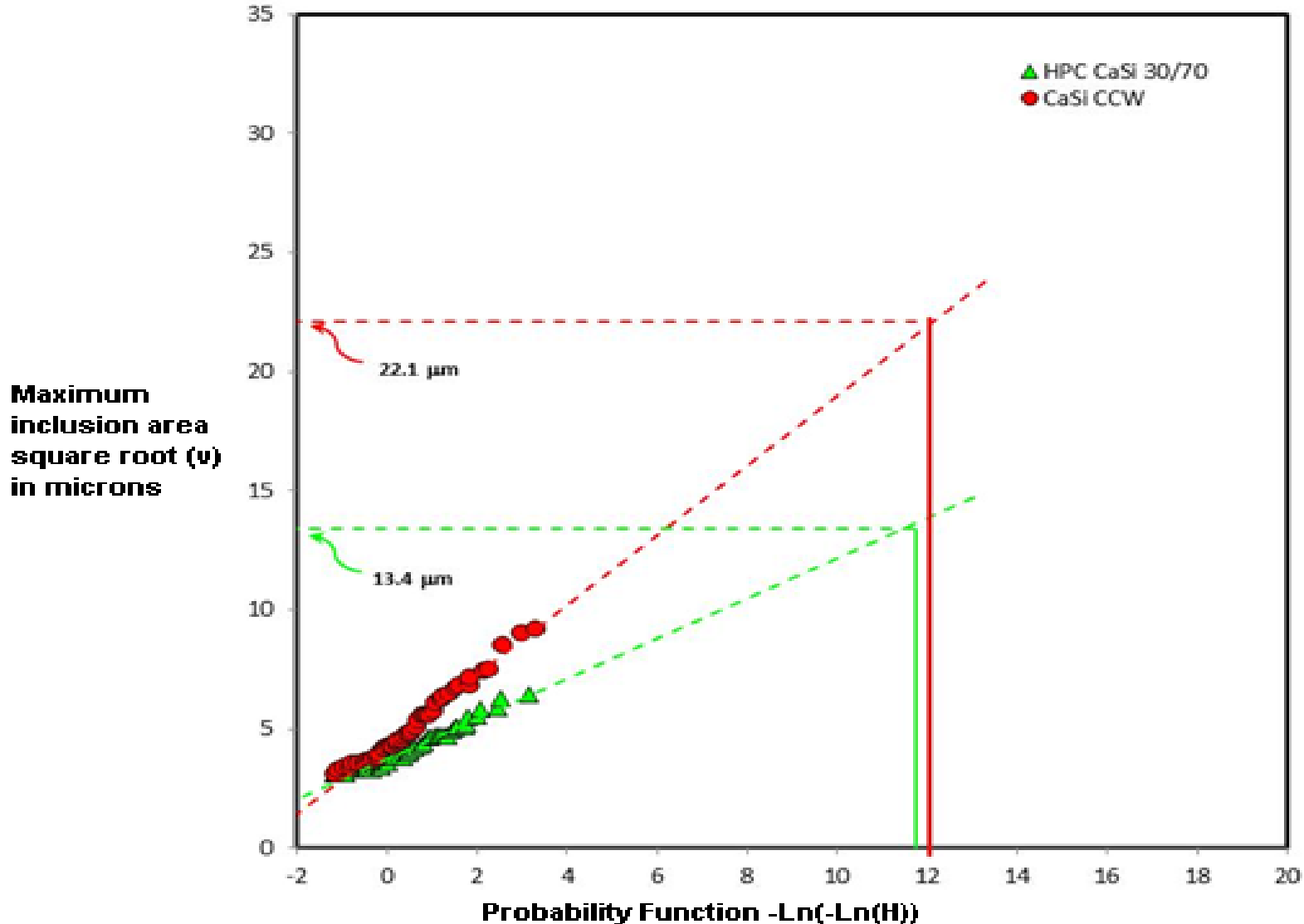
# Statistics of Extreme Value (S.E.V.)



- Murakami et al. developed S.E.V. based on measurement of the maximum sized inclusion in all microscopic fields in a given area.
- Used to discriminate between superclean steels.
- Will predict the maximum inclusion size in a large volume of steel based on measurement of the maximum inclusion in a very small volume of steel.

# S.E.V Comparison-

HPC 30/70 CaSi treatment vs Conventional Cored 30/60 CaSi



# Summary and Conclusions : HPC 30/70 CaSi Yield



- Average yield of 33.7% was obtained with HPC CaSi 30/70.
- Average consumption was 20.3 lb Ca/heat at .121 lb Ca/ton
- Optimum injection velocity was 400 feet/min
- Optimum yields were 43.4% with 16.3 lb Ca and .098 lb ca/ton.





# Inclusion Summary and Conclusions

- An immediate inclusion modification was achieved.
- Control of Al, and control of S to low levels favored successful modification.
- Low inclusion levels are associated with complete early modification promoting maximum flotation time

# Summary and Conclusions :

## Cleanliness



- Inclusion levels via S.E.V. analysis predict significantly smaller inclusion maximum size with HPC 30/70 CaSi as compared to conventional 30/60 CaSi.
- *While All steel producers* can achieve a measurable cleanliness benefit (This will be of particular importance to long products SBQ producers, as well as bearing and specialty steel producers, and should lead to higher quality end products in their customers operations.)



# Thank you for your kind attention

## Acknowledgements:

Center of Advanced Studies, National Polytechnic  
Institute, Saltillo Mexico

Department of Metallurgical Engineering: Manuel Castro  
Ph.D.

***Department of Mathematics: Martin Herrera Ph.D.***