HMS
Engineering Mathematics 1

Introduction

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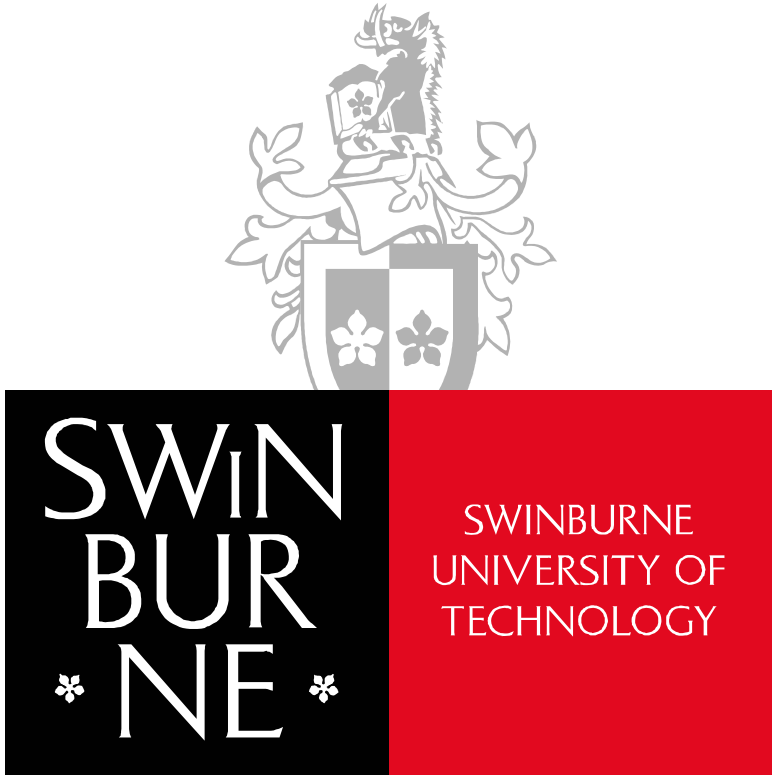
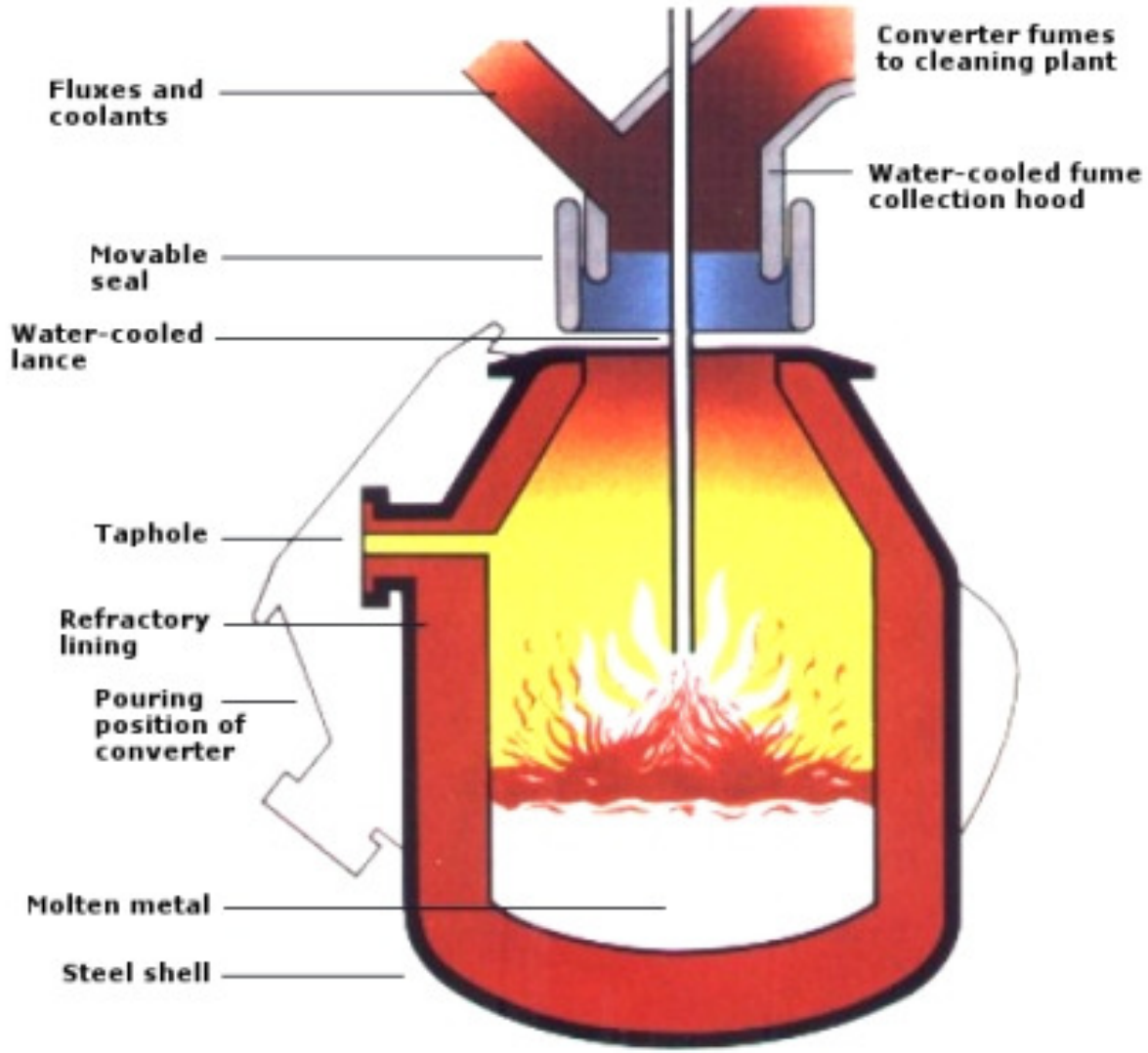


What is this subject about ?

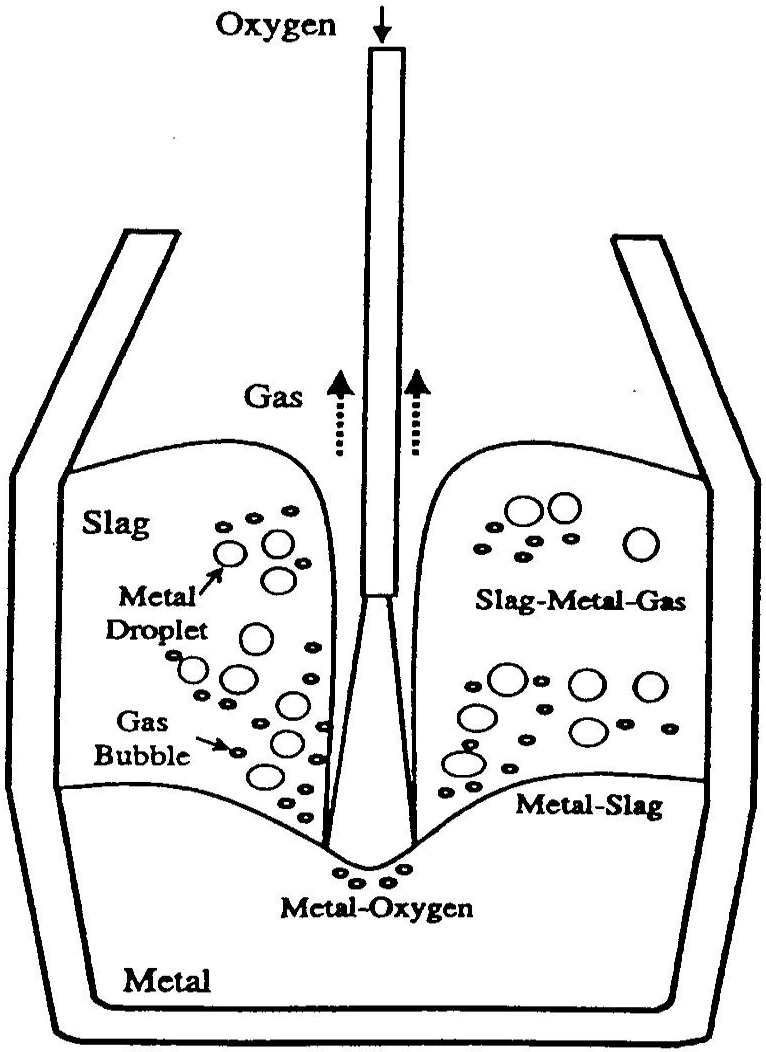
- Learning to use mathematics to solve Engineering problems

- Applying abstract thinking to practical problems

Image from www.niia.net/~alsman/bofmech/bof.jpg



www.corusgroup.com



Hot Zone

$O_2(g) = 2\underline{O}$

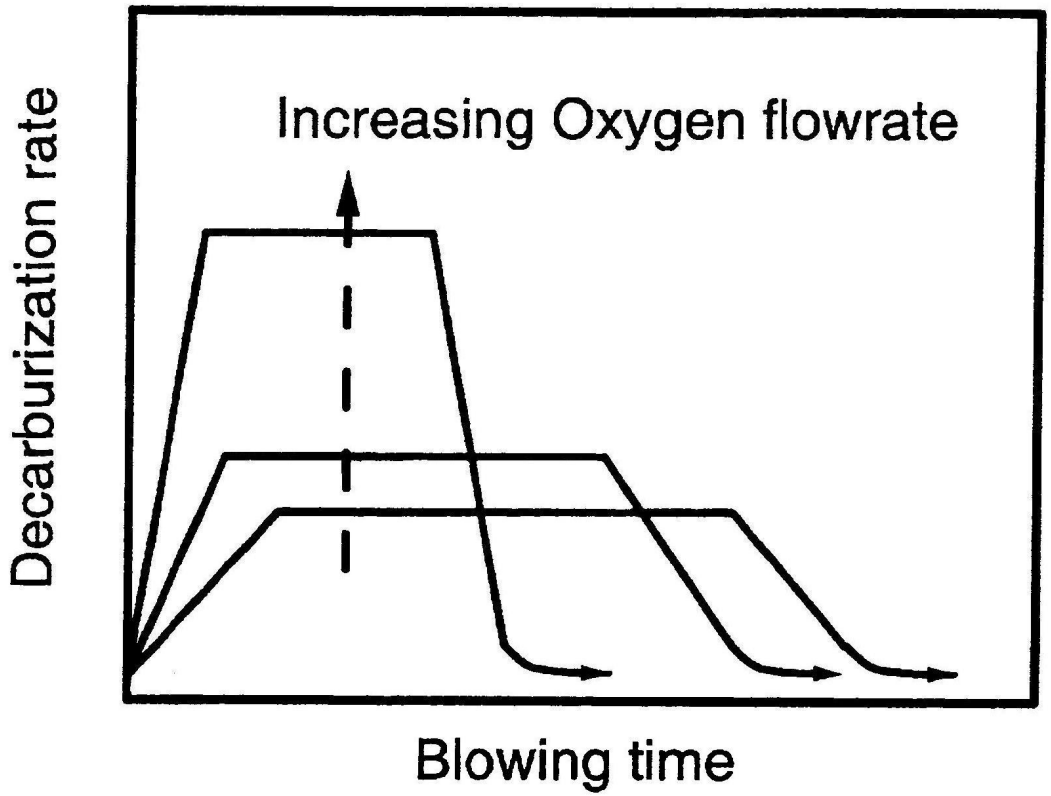
$\underline{O} + \underline{C} = CO(g)$

Emulsion

$(FeO) + \underline{C} = Fe + CO(g)$

Image from Brooks et al., 2002

Decarburization



Rate of decarburization during a typical oxygen steelmaking heat (after Deo & Boom)

Image from Brooks et al., 2002

How Fast ?

$$\frac{dC_b}{dt} = \frac{\left(\frac{A}{V}\right)(C_b - C_i)}{\left(\frac{1}{k}\right)} = \left(\frac{\text{Area}}{\text{Volume}}\right) \cdot \frac{\text{Drive}}{\text{Resistance}}$$

Droplet Ballistics

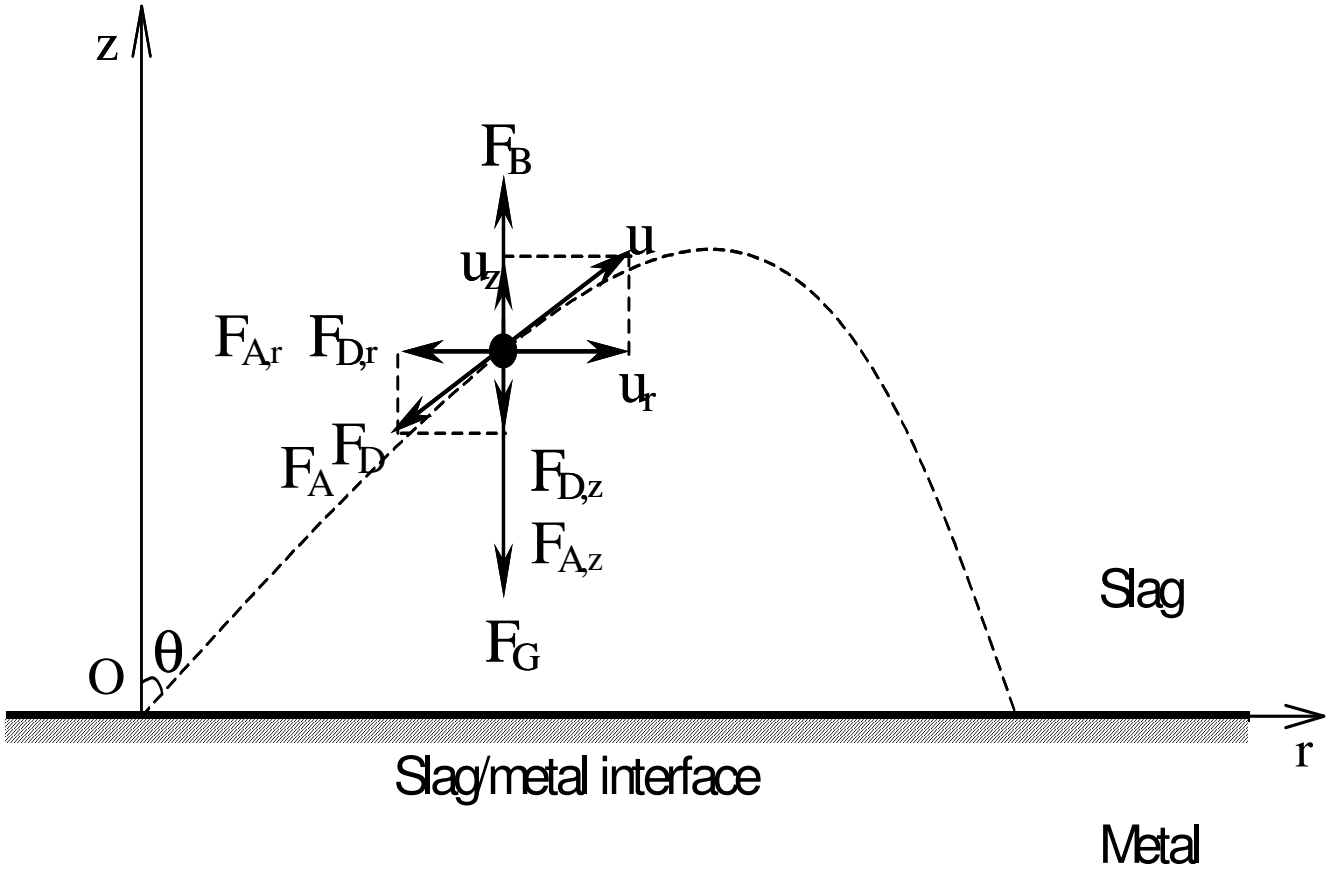
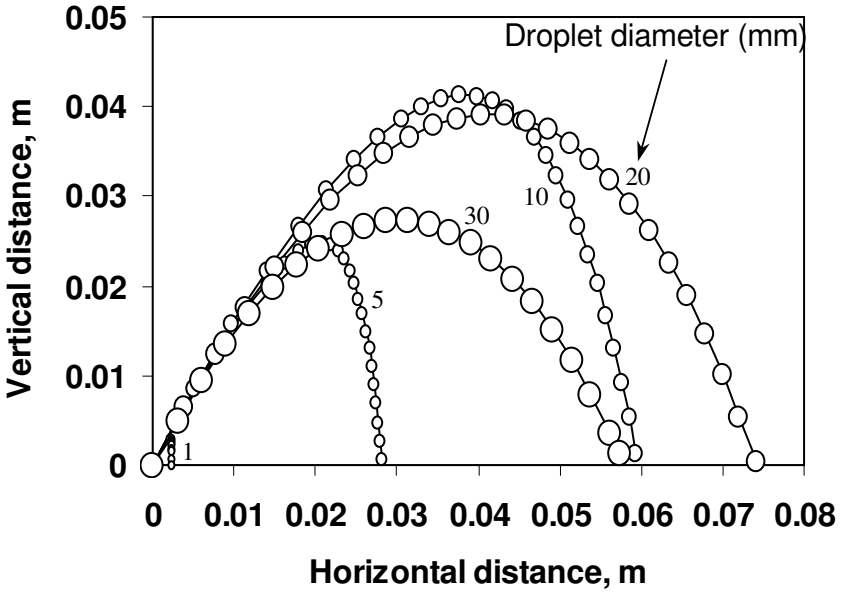
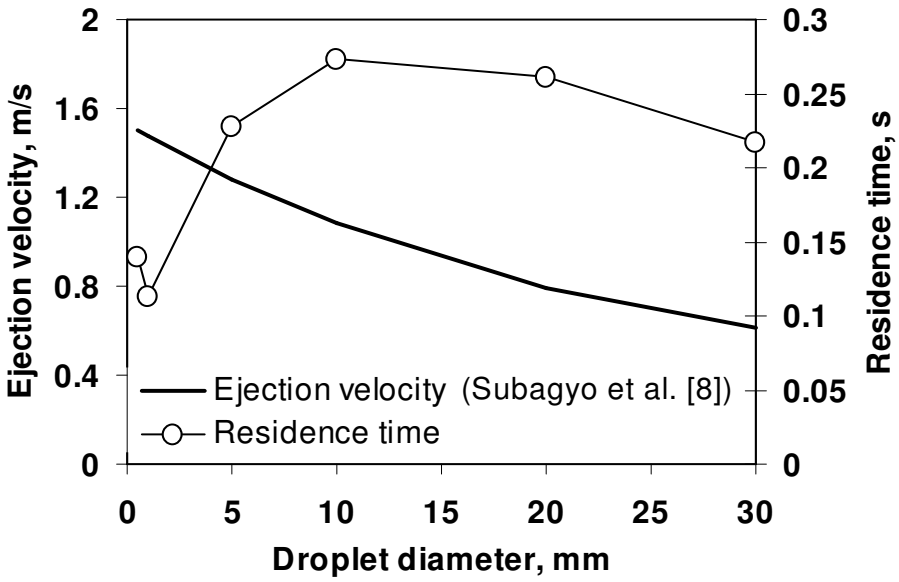


Image from Subagyo et al., 2004

Dense Droplets



(a) Trajectory of dense metal droplets



(b) Ejection velocity and residence time of dense metal droplets

Image from Brooks et al., 2006

Droplet Generation

Kelvin-Helmholtz Instability Criteria

$$N_B = \frac{\rho_G u_G^2}{2\sqrt{\sigma g \rho_L}}$$

R_B = droplet generation rate, kg/s

F_G = gas flow at lance exit, Nm^3/s

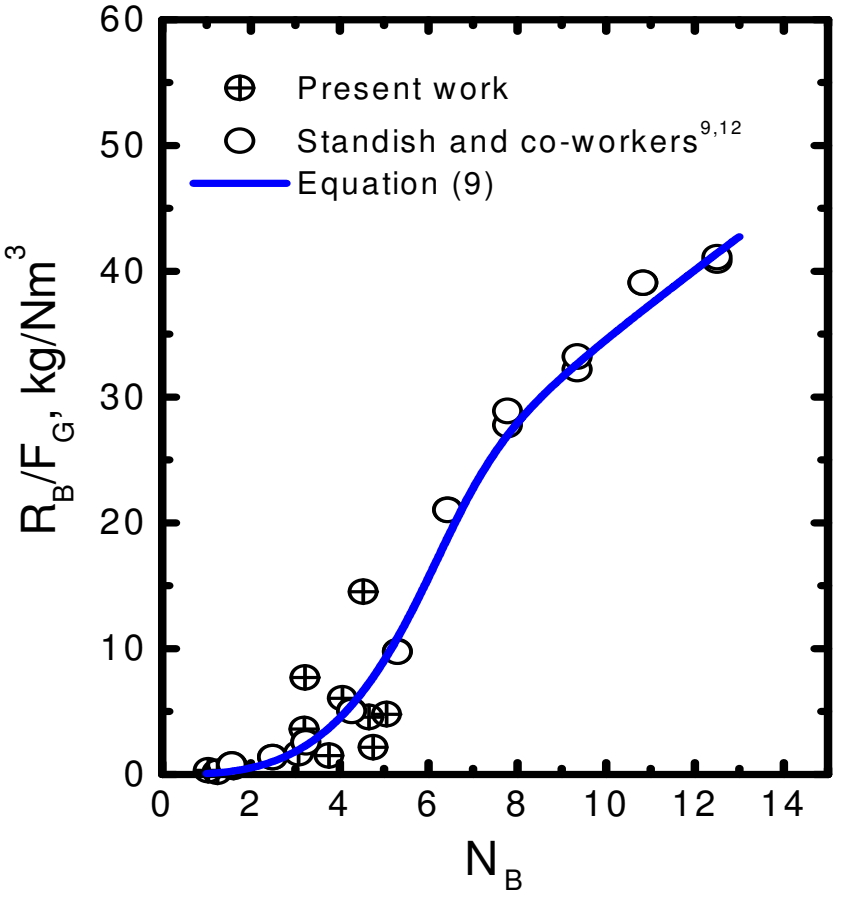


Image from Brooks et al., 2006

What is this subject about ?

Vectors (≈12%) : Basic Operations in 2 & 3D

In engineering, both magnitude and direction are important.

Numbers (≈8%): Binary, octal and hexadecimal systems

Machines don’t easily operate in decimal.

What is this subject about ?

Algebra (≈12%): Equations, graphical solutions, numerical solutions and transformations

In engineering, we form equations to describe a system, we use graphs to visualise the relationship and when we can't directly solve the equation we look for numerical solutions.

What is this subject about ?

Functions & Graphs (≈22%): polynominals, trigonometry, partial functions and hyperbolic

Functions are the tools we use to analyse engineering systems, a lot of systems can be described by just a few functions.

What is this subject about ?

Differentiation (≈24%): Rates, approximations, Taylor polynominals, implicit&logarithmic,

optimisation, limits & error analysis

Engineers need to understand how things change – Calculus is a powerful tool by which to analyse change.

What is this subject about ?

Integration (≈22%): Substitution, parts, areas, centroids, volumes, surfaces & numerical solutions

Engineers need to understand the end effect of change – Integration is the tool by which to “total” the effects a changing system.

Structure of Subject

- Four one hour lectures/tutorials
- One hour “seminar” class (optional)
- Assessment - 50 minute test (15%) in week 6
  - 50 minute test (15%) in week 11
  - 3 hr final exam (55%)
  - 11 weekly assignments (15%)

Textbooks

HMS 111 Engineering Mathematics 1 Student Notes – ALL student should access to a copy

Assumed use of a graphics calculator

CAS calculators allowed in first test and final exam

Useful but not necessary to purchase

A. Croft et al., Engineering Mathematics: A Modern Foundation for Electronic, Electrical and Systems Engineers, Addison-Wesley, 1996

J. Glyn, Modern Engineering Mathematics, Addison-Wesley, 1993

K.A. Stroud, Engineering Mathematics 5th Ed., Macmillan, London, 2001

How to succeed in this subject ?

- Read the subject outline – What is expected of you ?
- Get the Student Notes
- Pay attention in classes and tutorials
- Complete the problems – learn to solve not rote learn recipes
- Get help when your lost – me, your friends, textbooks, maths and stats help centre, on line tutorial (Blackboard), etc

PAY ATTENTION – THINK – WORK CONSISTENTLY