

Institute Of Refractories Engineers

Batching and Mixing of Refractories

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Batching and Mixing Overview

- Aggregate Processing
- Aggregate Characterisation sizes
- Blending
- Density of Aggregates
- Product Production



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- Crushing and Grading
- Refractory Aggregates
 - Size
 - Shape
 - Density



Batching and Mixing Crushing and Grading





Batching and Mixing Grain Size – Typical Sieve Sizes





Batching and Mixing Aggregate Size





Batching and Mixing Aggregate Characterisation

Sieve Analysis (% retained)

Sieve Size (mm)	Brown Fused Alumina				
	-10.0 + 5.0	-5.0 + 3.0	-3.0 + 1.0	-1.0 + 0.5	-0.5 + 0.0
9.500					
8.000	24.0				
4.000	74.0	45.0			
2.800	2.0	55.0	2.0		
2.000			15.0		
1.000			80.0		
0.500			3.0	98.0	2.0
0.300				2.0	27.0
0.250					11.0
0.125					30.0
0.075					15.0
-0.075					15.0



Batching and Mixing Fillers and Binders

Cement Calcined Alumina Reactive Alumina Mineral Clay Volatilised Silica Carbon Black < 45µm < 30µm ≈ 10 – 0.1µm < 1µm ≈ 1 – 0.1µm < 0.1µm



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- Ideal Particle Packing
- Practical Particle Packing
- Mathematical Model



Batching and Mixing Packing of Spheres



Ideal Packing of Spheres (in one plane)

Voids are filled using progressively smaller particles



In this case, the mathematical model used to calculate the quantity and size of progressively smaller particles needed to achieve maximum density assumes that all the particles are spherical and are the same density



Batching and Mixing Raw Material Grain Shape











Batching and Mixing Raw Material Density



100g Zircon Sand



100g Fused Alumina



100g Chamotte



Batching and Mixing Raw Material Density







Batching and Mixing Particle Packing





Batching and Mixing Andreasen Distribution

$$X = 100 \left(\frac{d}{D}\right)^{q}$$

Where

- X = % passing size d
- D = Diameter of largest particle
- q = Variable to control the relative proportion of fine and coarse particles (distribution modulus)



Batching and Mixing Andreasen Distribution Curves





Batching and Mixing Andreasen Distribution Curves





Batching and Mixing Refractory Mix

70
25.0
20.0
25.0
15.0
5.0
10.0
+0.1



Batching and Mixing Simple Mix





Batching and Mixing Manufacture and Installation



Aggregate

Matrix



- There are 100's of different Aggregates available to produce the various mix compositions used.
- There are also 100's of Additives available which impart the required properties to the refractory mix.
- The combination of Aggregates, Additives and Production Process give the required texture to the Refractory mix.





Batching and Mixing Summary

- Natural and synthetic aggregates are crushed and used as graded product.
- Aggregates are blended with fillers and binders in specific proportions to achieve required properties and texture.
- Composition is specifically designed for a given application.
- Production operation could be simple 'dry mixing' or 'wet mixing' to produce mouldables and mortars.



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Batching and Mixing of Refractories

Thank you for your attention

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