Technical Bulletin –
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Introduction

Structure of x-ray fluxes - Granular verses Microbeads

The physical structure of x-ray fluxes should be seriously considered in achieving faster fusion times and therefore faster throughput of analysis.

The physical characteristics of granular (convoluted surface) flux and microbead (spherical round surface) flux are markedly different with respect to surface area and this has a significant bearing on the melting or fusion times for the analytical procedure e.g.

a) **We have found that granular flux has about 38% more surface area than microbeads for any given weight.**

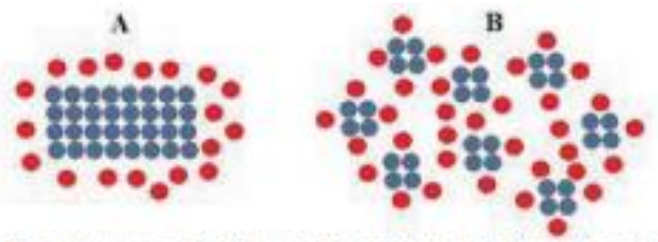
b) **Collision theory states that – The greater the surface area that is available for particles to collide, the faster the frequency of collisions and this increases the chances of effective collision thus leading to a faster reaction. The very first requirement for a reaction to occur between reactant particles is that the particles must collide with one another.**

c) **We have found in practice that the melting or fusion times using the granular form of x-ray flux is approximately 20% less than using the microbead form of x-ray flux**

d) **With respect to chemical composition both forms of x-ray flux as manufactured by XRF Chemicals Pty Ltd are identical**

In order to explain the above in a simplistic manner we explain further as below:

Consider a reaction between reactant RED and reactant BLUE in which reactant blue has been broken up into many smaller particles



In these figures, only the particles on the outside of the solid blue reactant have a chance to collide with the red reactant. In figure B, the same amount of solid reactant as used in A was crushed into smaller particles. This means that more particles on the outside of the reactant have an opportunity to collide with the red reactant and speeds up the reaction.

In the diagram, only the blue particles on the outside surface of the lump are available for collision with reactant red. The blue particles on the interior of the lump are protected by the blue particles on the surface. In Figure A, if you count the number of blue particles available for collision, you will find that only 20 blue particles could be struck by a single particle of reactant red.

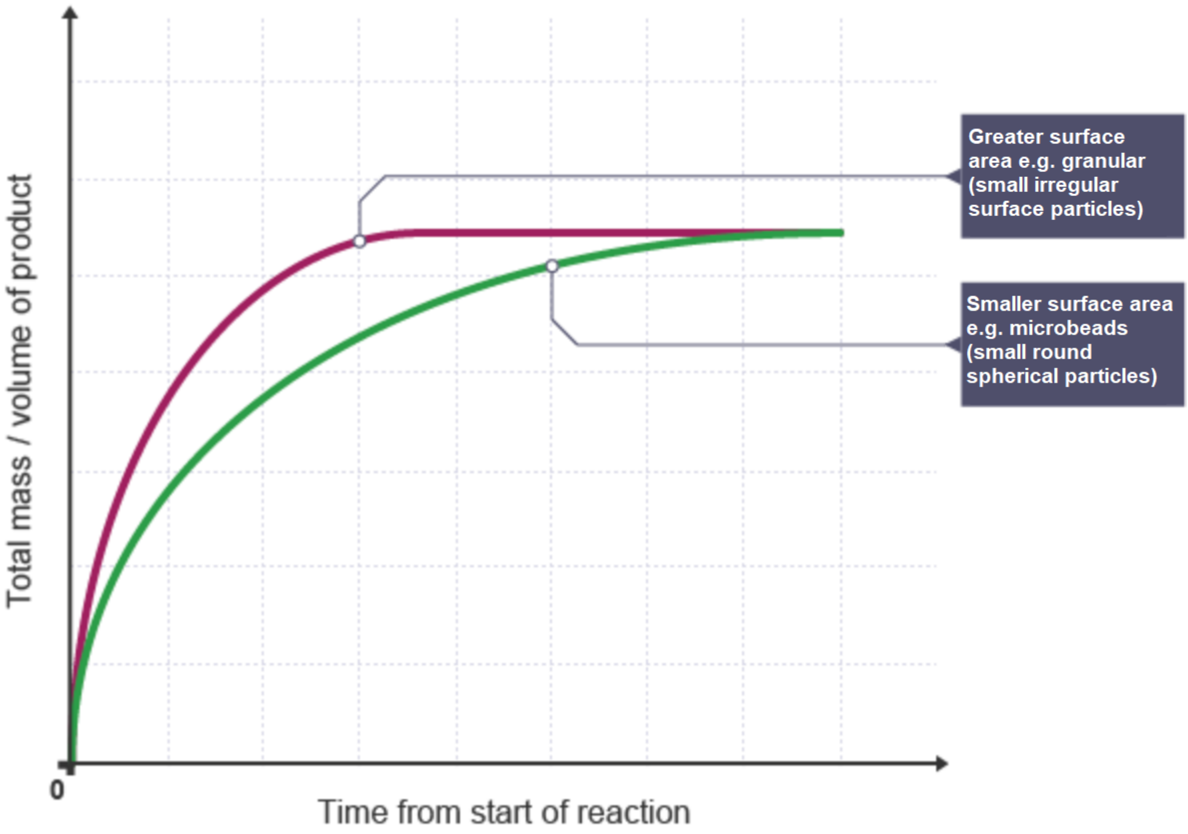
In Figure A, there are a number of blue particles on the interior of the lump that cannot be struck. In Figure B, however, the lump has been broken up into smaller pieces and all the interior blue particles are now on a surface and available for collision.

In Figure B, more collisions between the blue and red will occur, and therefore, the reaction in Figure B will occur at a faster rate than the same reaction in Figure A i.e.

Increasing the surface area of a reactant increases the frequency of collisions and increases the reaction rate as in (b) previously.

If the surface area of a reactant is increased:

- **more particles are exposed to the other reactant**
- **there is a greater chance of particles colliding, which leads to more successful collisions per second**
- **the rate of reaction increases**



Compared to a reaction with round spherical particles of reactant, the graph line for the same reaction but with granular irregular particles of powdered reactant:

- **has a steeper gradient at the start**
- **becomes horizontal sooner**

This shows that the rate of reaction is greater when the surface area is increased.

Several smaller particles have more surface area than one large particle.

The more surface area (38% greater in XRF Chemicals granular flux compared with microbeads) that is available for particles to collide, the faster the reaction will occur (20% faster) as stated above and in (a) to (c) previously.

XRF Chemicals manufacture and supply both granular and microbead form of x-ray fluxes