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CRUSHER SELECTION II

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Introduction

What's this Reduction Ratio all about?

When someone starts looking for a crusher, one of the points that needs to be considered is that of the Reduction Ratio.

Obviously no crusher is capable of producing a very fine product from an extremely coarse feed, and this is where the Reduction Ratio (often written R/R for short) comes into it.

The Reduction Ratio is broadly defined as the ratio of the feed size to the product size in any crushing operation. It is very useful in determining what a crusher can do, or is doing, in the way of size reduction. It can also be used as a partial indicator of the stresses the crusher will be subjected to during operation, an element in determining the crusher capacity and as an indicator of crusher efficiency. However, there is no one method of calculation which will provide a useful figure for all of these considerations, so there are various types of Reduction Ratios in use, depending on how technical you wish to get.

The **Limiting Reduction Ratio** is the ratio of the maximum feed size (F100) to the maximum product size (p100). It is the ratio that is normally understood when reduction ratio is discussed without defining it further, and is probably the easiest to estimate if the actual details of the installation are not available. This figure can obviously be distorted, particularly when referring to primary crusher feed, because the F100 for primaries is normally the expected lump in one direction from a blast or passing through a grizzly, whereas product is generally sized on a square or round mesh, which measures intermediate dimensions of a particle. This is because a slabby product does not easily pass through a screen aperture and thus doesn't contribute to the p100 figure.

The **80% Reduction Ratio** is the other one often referred to by manufacturers. It is the ratio of the theoretical square mesh aperture that will pass 80% of the feed (F80) and 80% of the product (p80). It was originally derived to get away from the problems caused by the presence of a small proportion of coarse slabby material when using the Limiting Reduction Ratio in calculations. This is probably the best ratio to use when sizing a crusher or determining the performance of an existing installation, as it removes many of the inaccuracies that can be introduced when using the Limiting Reduction Ratio.

These ratios are those most commonly referred to when selecting a suitable machine for an application. Just to confuse the issue, there are several other R/Rs that may be used, but these are generally more applicable in the design of crushers or assessment of the performance than in the selection of the machines. As such they are rarely considered (or even mentioned) when selecting a machine for an installation.

The table below shows the average R/Rs that apply to the most popular types of crushers in use in quarries today. It should be noted that these are averages, and specific machines may achieve better (or worse) R/Rs, depending on design and application.

Single or double toggle jaw crusher	6:1
Gyratory crusher	8:1
Standard head cone crusher	7:1
Fine (short) head cone crusher	5:1
Hammermill or Impactor	Up to 10:1

Using these figures it is obvious that, if you have a projected feed, be it F100 or F80, of 250mm and are looking for a p100/ p80 of 20mm, it is going to be difficult if not impossible to get this from the one stage of crushing.

Crusher manufacturers should look at the reduction ratio when selecting a suitable machine to make sure that the selected unit will perform to the requirements of the customer. If they consider the client is asking too much from one machine they will suggest the application is unsuitable for one crusher and recommend alternatives. After all, if they select one unsuitable machine for the job when it really needs two it won't take long for the word to get around that the "XYZ crusher I just installed" is a terrible machine, doesn't perform, is not up to the job. This could easily expand to reflect on all "XYZ brand" machines, giving them a poor reputation. Obviously no manufacturer wants this, and in reality the crusher is fine, it's just incorrectly applied.

Definitions of Reduction Ratios from "Handbook of Mineral Dressing- Ores and Industrial Minerals" by Arthur F. Taggart, published by John Wiley & Sons, Inc.

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