



QUARRY ACADEMY

Improving Processes. Instilling Expertise.



HSI Crushers

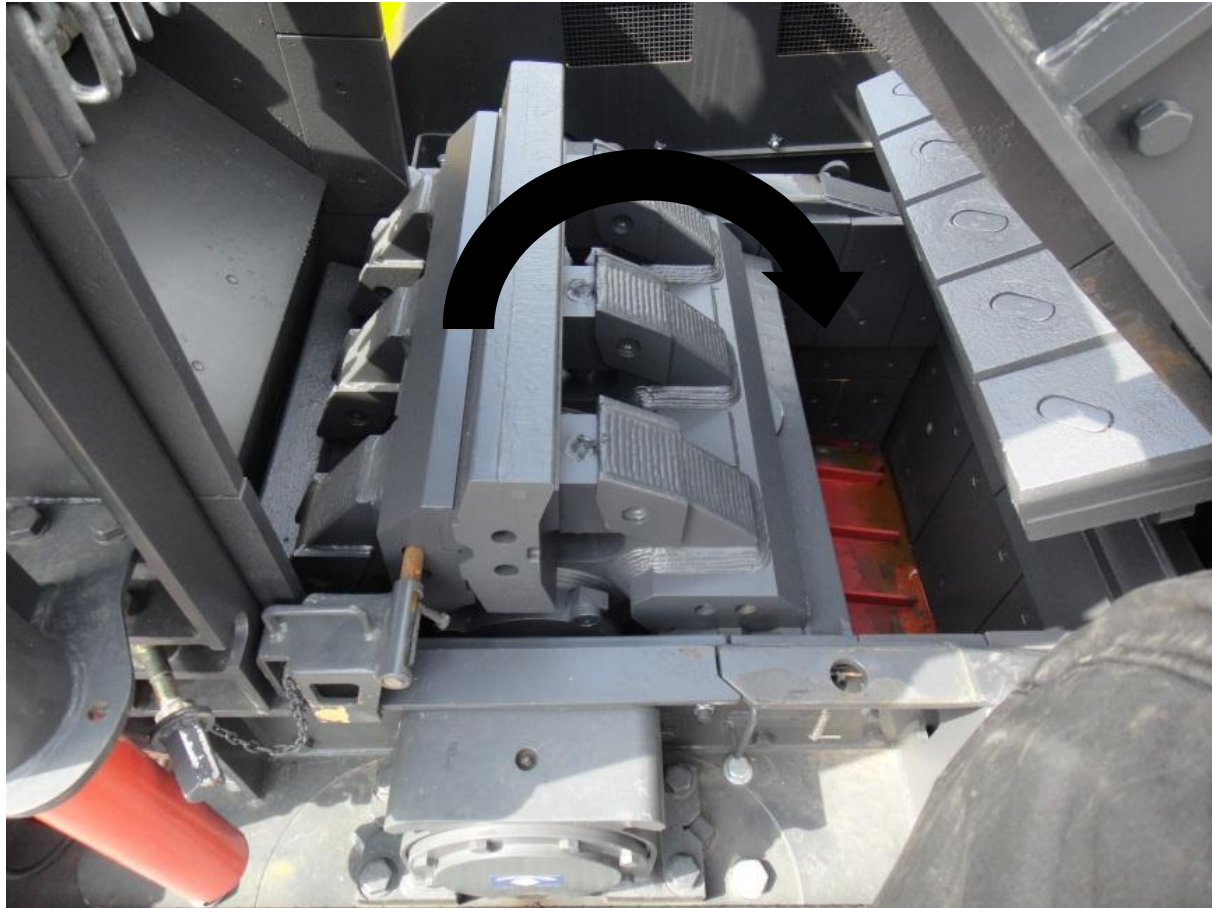
Basic Principles - Crusher



- Horizontal Shaft Impact crusher, commonly referred to as HSI's are the largest volume selling type of crusher in the world, outselling all other crusher types.
- Two main variants of HSI crushers are marketed, Primary and Secondary.
- Primary crushers can take feed sizes typically up to one metre in size (40" inch) and produce a secondary material size (150mm to 200mm). (6"-8" inch)
- Secondary crushers typically take a feed size of about 200mm (6-8 inch) to produce a range of aggregate sizes from sand up to generally 25 mm.(1" inch)
- Historically HSI crushers are most effective when used on relatively low abrasion index material (up to 0.3 Ai) but are also very effective when being utilised in the recycling industry, especially in the recycling of re-enforced concrete or asphalt.
- They have high reduction ratios of typically 10 to 1 and sometimes even greater, which makes them ideal to replace a stage of crushing (in a typical 3 stage crushing plant) but can also be operated as a single stage crusher.

HSI Crushers

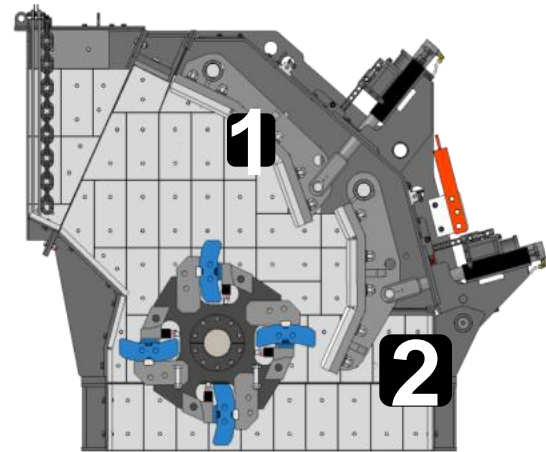
Basic Principles - Rotor



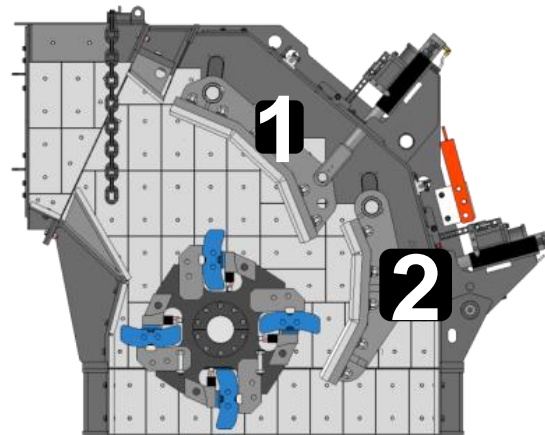
- HSI crushers have one main method of crushing, that of impact. This impact comes primarily from a high speed rotating rotor, mounted horizontally in the crusher and fitted with replaceable hammers.
- The hammers are manufactured from a high wearing material that can also withstand the high energy impact forces within the crusher.
- The rotor design is an important factor in the efficiency of the crusher. The width of the rotor, the weight or mass of the rotor combined with the efficiency of the hammer design are all major factors which should be considered.
- Generally the width of the rotor will dictate the capacity of the crusher, i.e. how much rock we can process through the crusher.
- The weight or mass of the rotor will effect the breakage ratio of the rock, combined with the ability to reduce power spikes and surges during operation, that could cause bearing failure, and or drive transmission problems.
- The hammers and the design of them are also important factors to be considered in the efficient operation of the crusher.
- The shape and size of the hammers give not only maximum impact, but also shears the incoming rock, thus ensuring maximum reduction.
- Hammers with good wear characteristics and good design shape will promote better shearing and breakage of the rocks whilst good hammer metallurgy will result in extended hammer life and lower operating costs.

HSI Crushers

Basic Principles - Curtains



Primary Crusher

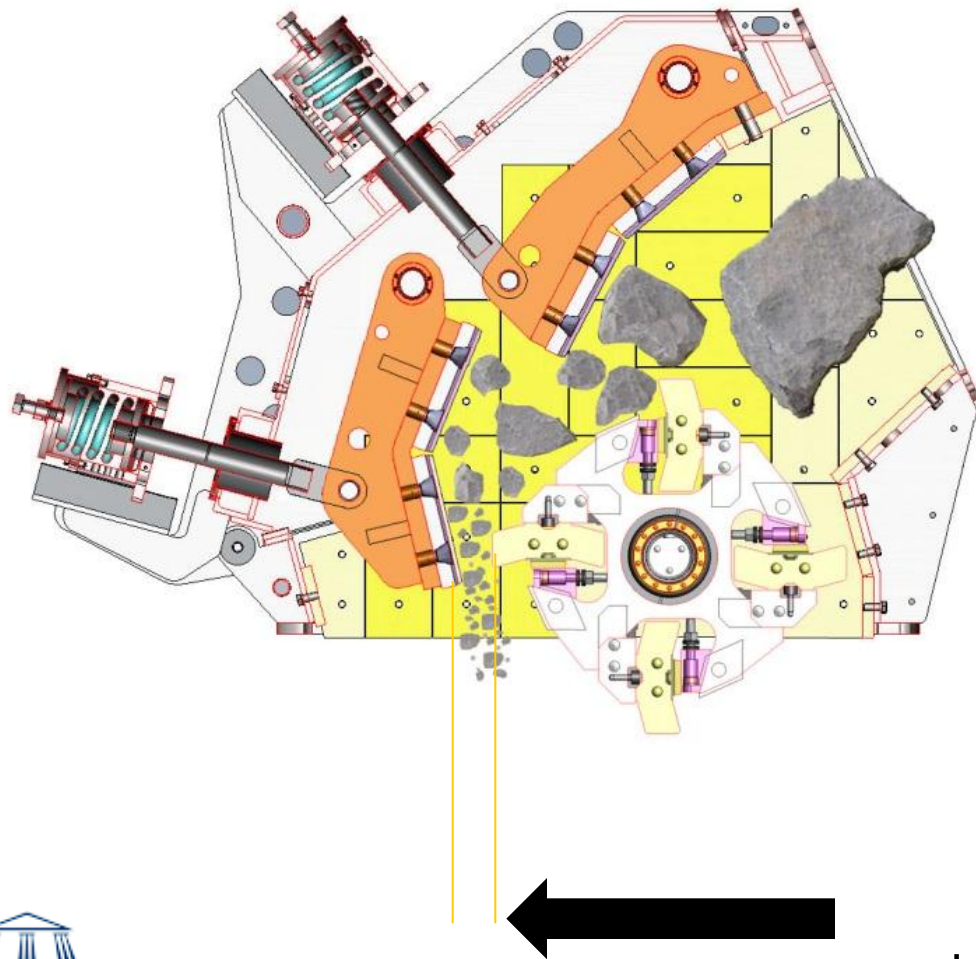


Secondary Crusher

- Secondary breakage comes from the curtains. As can be seen from the cross section models there are two curtains in each crusher type. The first curtain (1) in conjunction with the hammers, does the initial (and greatest) size reduction.
- The second curtain (2) does the final crushing to deliver the product size distribution required from the crusher.
- The shape, design and positioning of the curtains within the crushing chamber all have a dramatic effect on the efficiency of the crusher. Also the ability to maintain the setting of the curtains (i.e. the set gap between the rotor hammers and the toe edge of the curtains) is very important as it will have a direct effect on the crushers performance in terms of particle size distribution out of the crusher.

HSI Crushers

Basic Principles – How it works

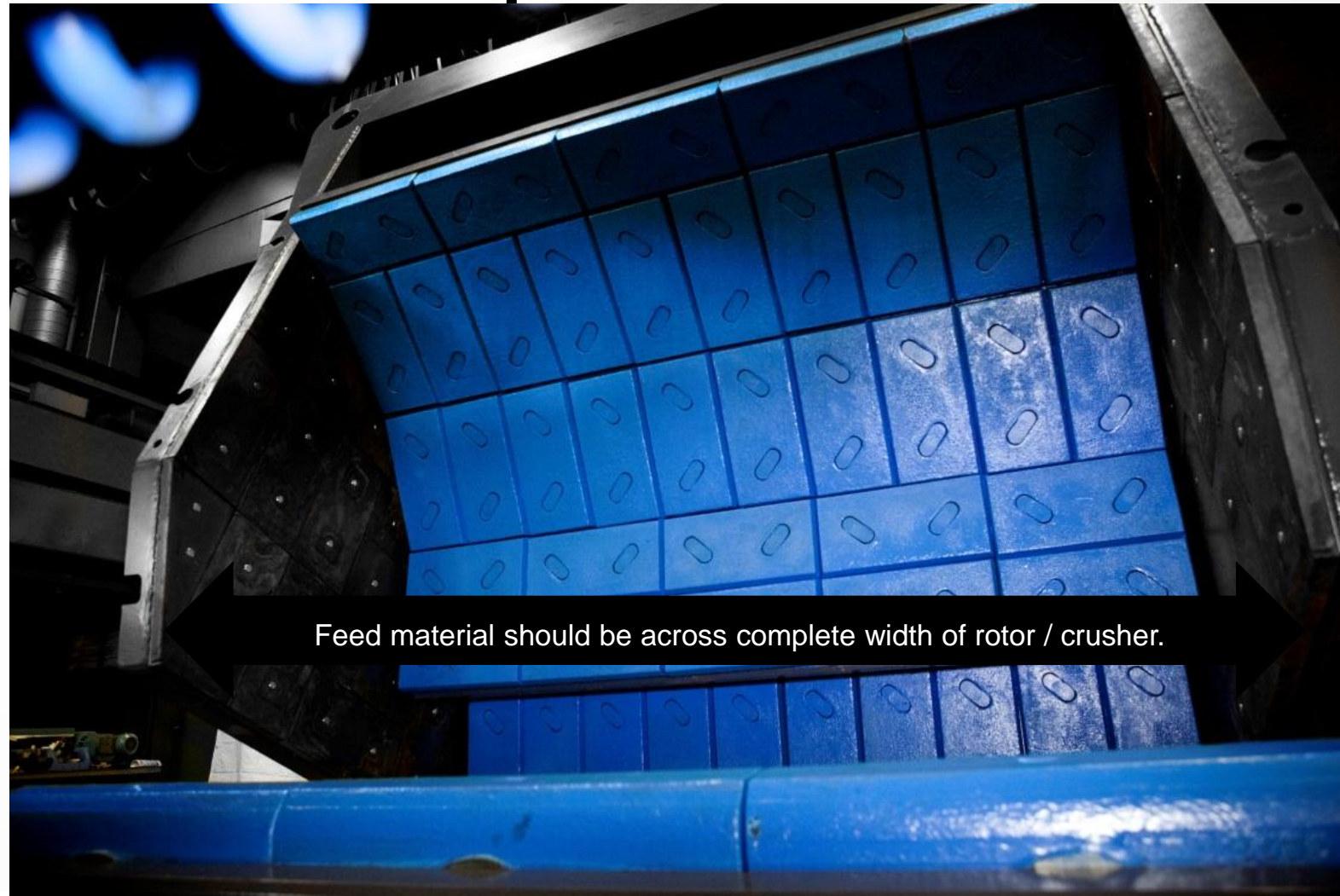


- The crusher works by feeding rocks into the crusher, either by a mechanical feeder for Primary crushers, or by means of gravity from either a feeder or conveyor for Secondary crushers.
- The feed material is directed into the first crushing chamber via the feed chute, where it comes into contact with the hammers of the rotating rotor.
- The incoming rock impacts against the hammers in the rotor thus causing the first stage of breaking of the rock. From the first impact when the rocks come into contact with the hammers on the high speed rotating rotor, broken rock from the hammers is then accelerated against the first curtain, where secondary breakage occurs. This rock then falls back towards the rotor, where more impact and breaking occurs when it comes into contact again with the hammers of the rotating rotor and this process is repeated many times. Once the material has become smaller than the gap between the hammer top edge and the toe of the curtain, it then falls through, into the second chamber (second curtain) , where the whole process is repeated.
- This crushing action results in very good product shape with low flake and elongation indices.
- Once the rock has been crushed to a particle size below the gap setting between the hammer top edge and the toe of the second curtain, it falls down into the discharge chute and out of the crusher.

2nd Curtain Gap = 80% Product size required.

HSI Crushers

Basic Principles – How it works



- It is vitally important for the efficient operation of the crusher, that the incoming feed material is distributed evenly across the full width of the rotor.
- It is also important the crusher is never “choke fed” , as is sometimes the case for some other crushers.
- Feed material should be adjusted to ensure a steady, even and uninterrupted flow into the crusher whilst ensuring that motor full load amps (power) are never exceeded.
- Choke feeding of the crusher will result in rapid hammer and wear part wear combined with reduced crusher throughput.
- Not feeding the feed material across the complete width of the rotor (feed opening), will result in rapid hammer wear and curtain liner wear, either to one side of the crusher, or the other or even in the middle.

Impactor Principles

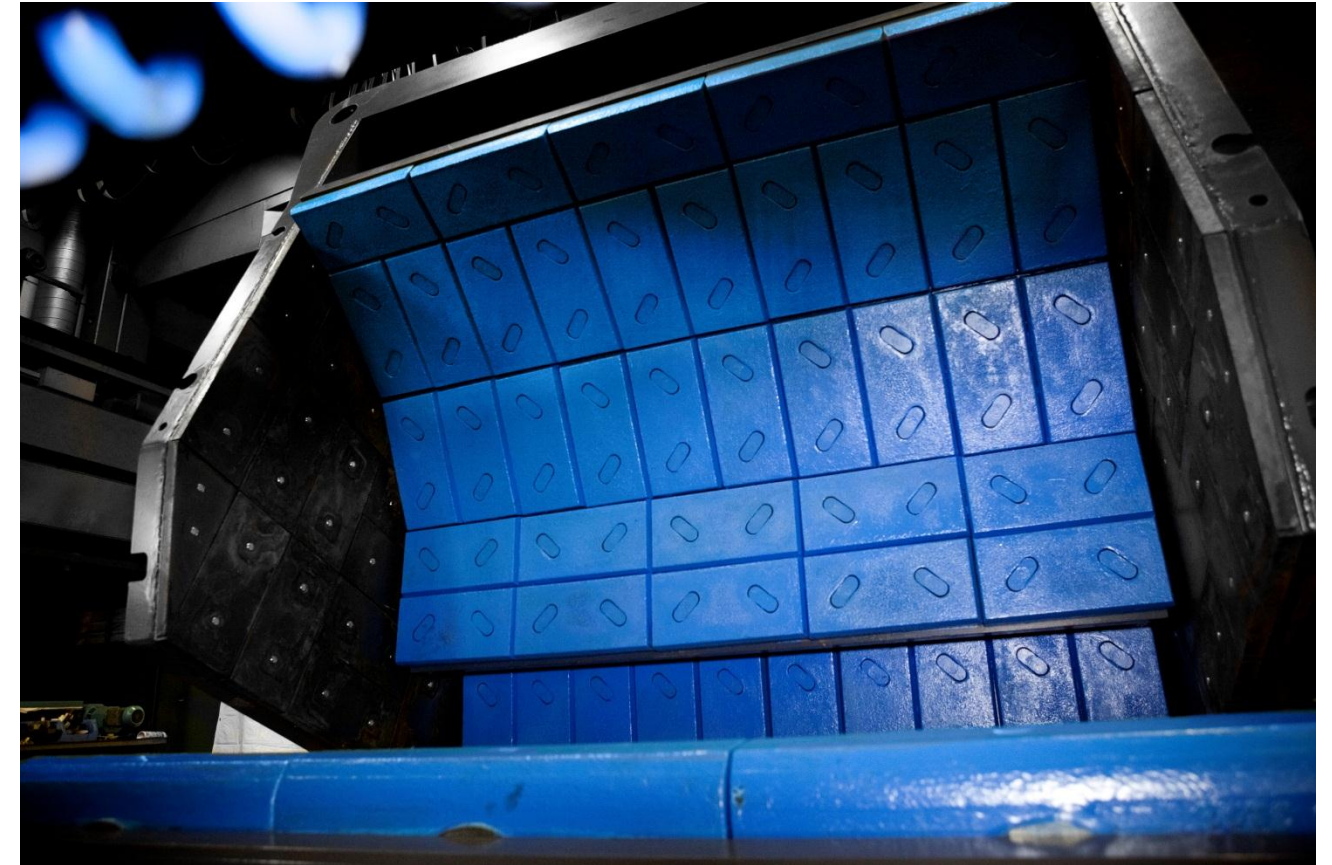
● In General

- Impactors generally produce a good cubical product.
- Impactors can achieve much higher reduction ratios than compression type crushers.
- Impactors can very often do the same job as a jaw and cone combination. ?
- Due to high wear costs, Impactors should not be used in very abrasive applications.?
- Impactors generally produce a wider range of sizes from a given feed gradation.
- Impactors generally produce better shaped fines than compression crushing.
- Impactors are most effective with larger feed sizes.
- Impactors generally find the natural fracture zones within the material.
- With the advancement in metallurgies more applications are now being opened up to impact crushers.

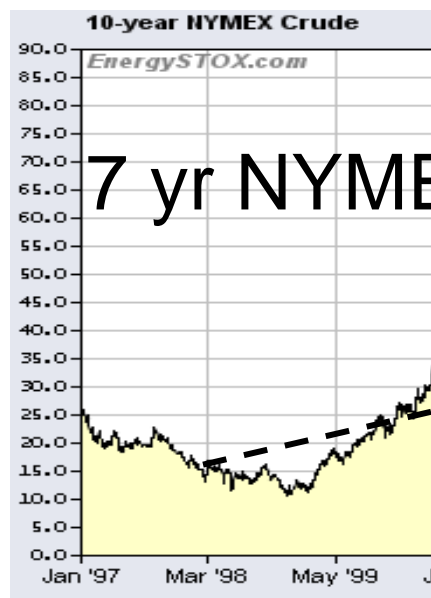
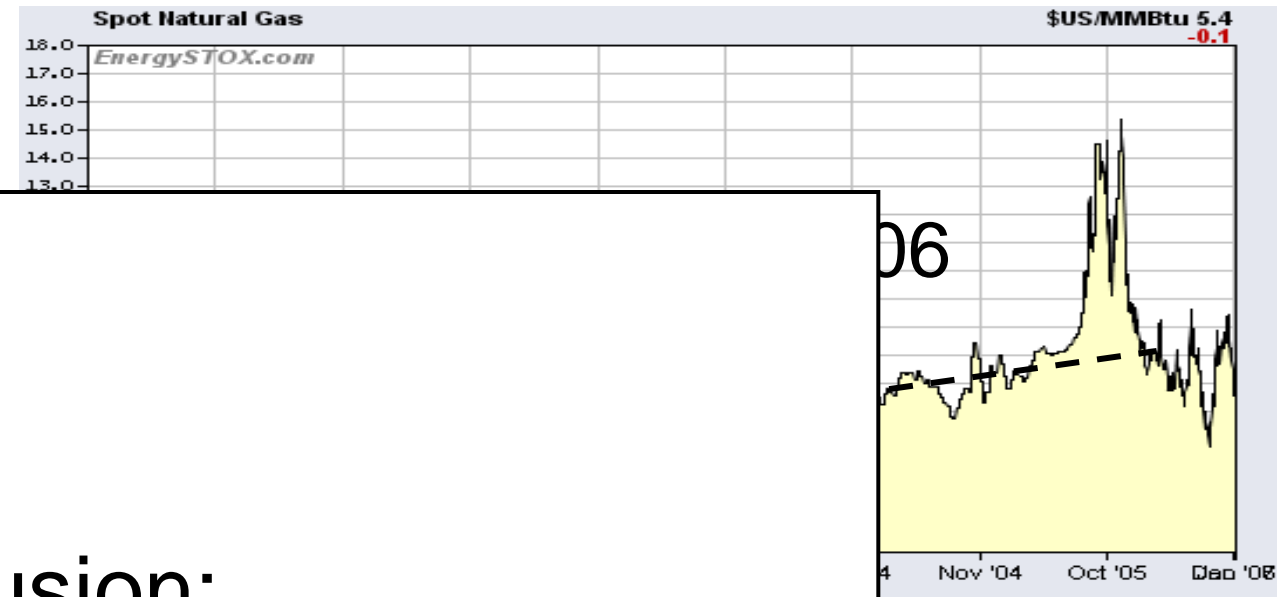
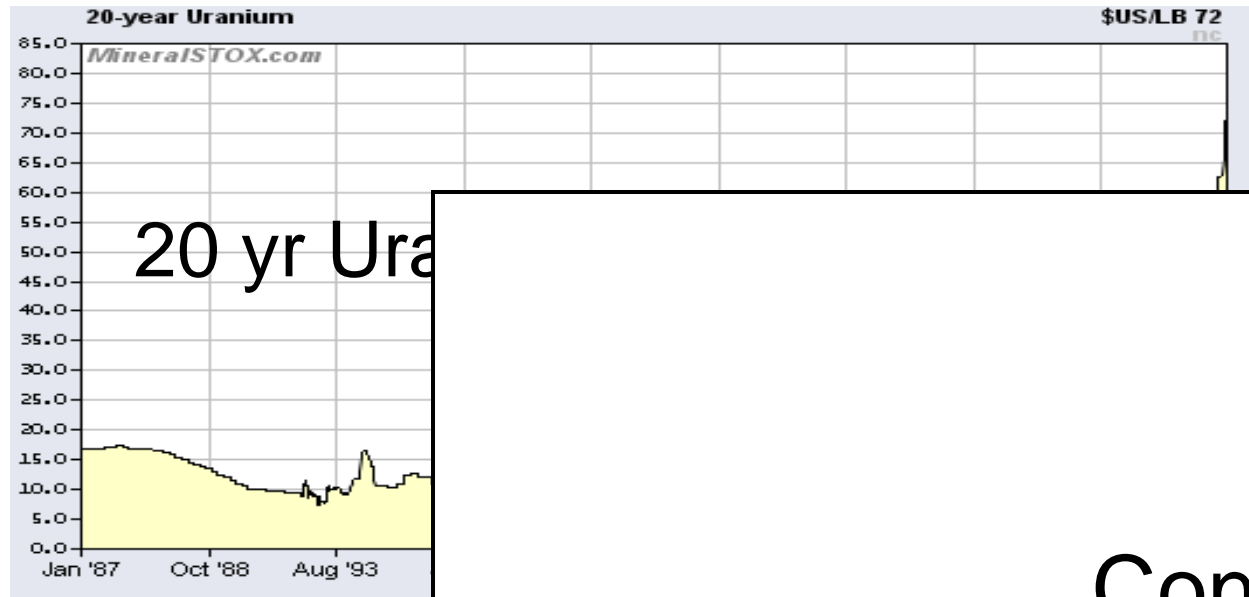


A break with Tradition

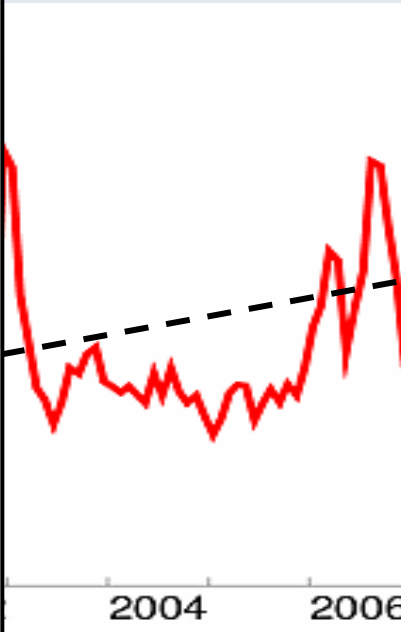
- Traditionally impactors have been used in low abrasive applications.
- Now with the introduction of different metallurgies (ceramic inlays, cast in carbides) higher abrasion applications can now be accepted.



We are moving towards a sellers market for many sources of energy!



Conclusion:
Energy conservation will become increasingly important in the future !

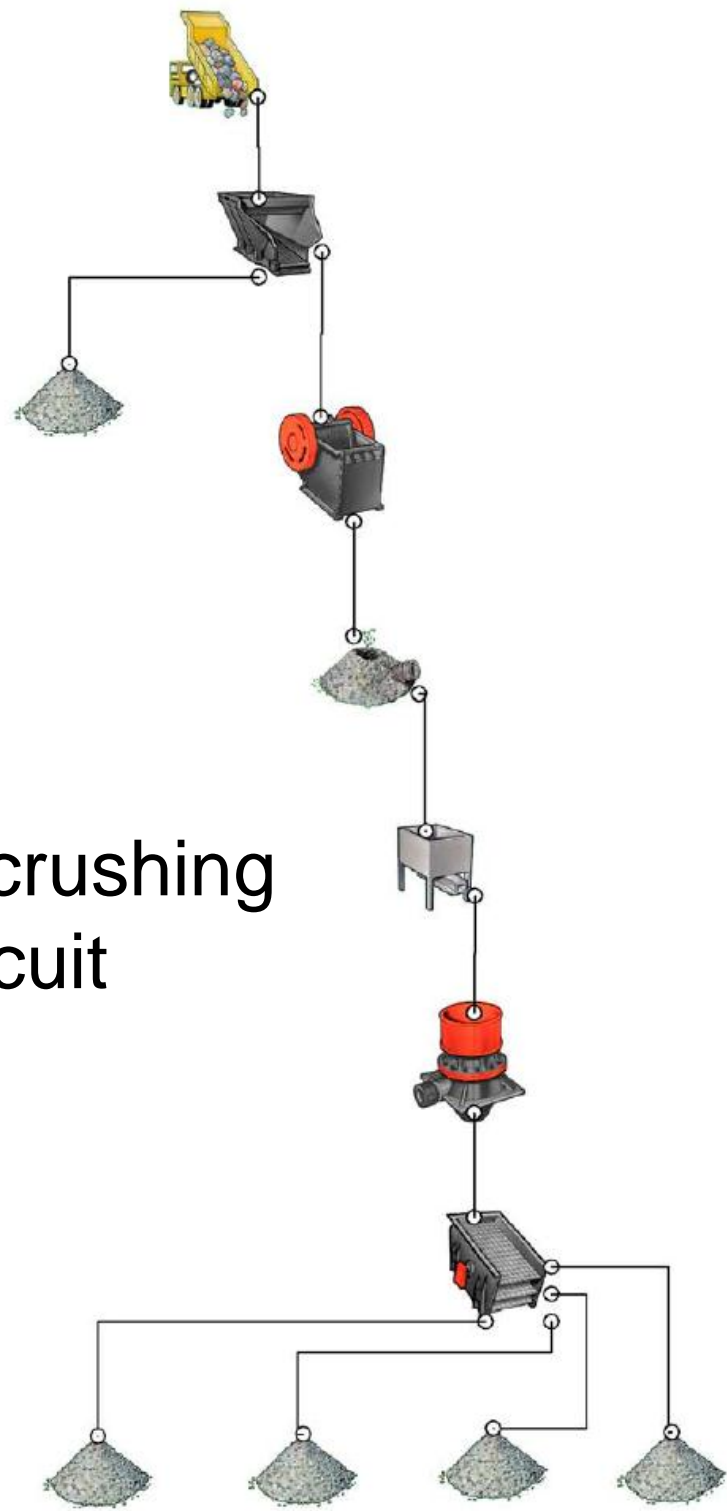


Why we have to change

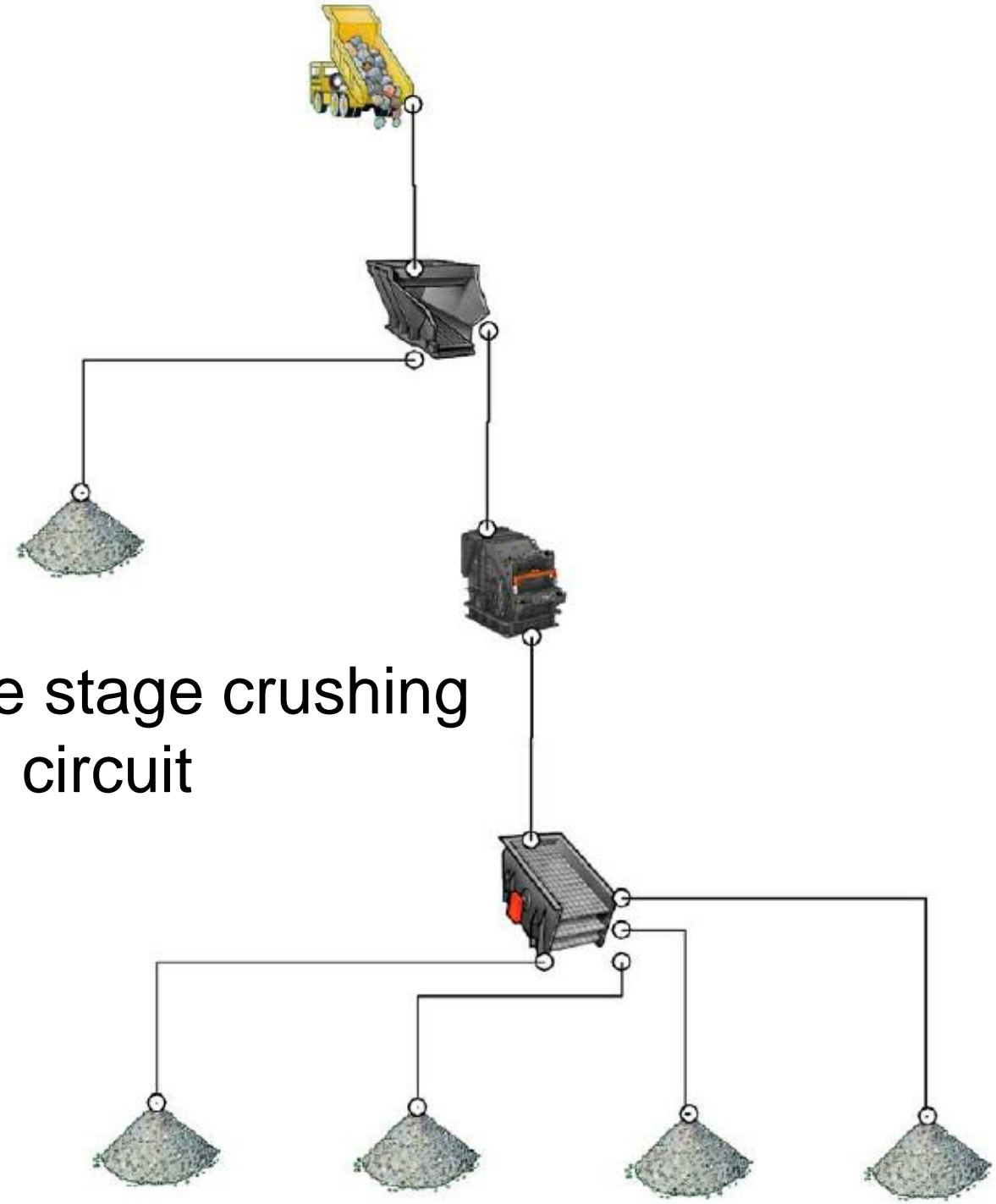


We can no longer bury our heads in the “sand”





2 Stage crushing
Open circuit

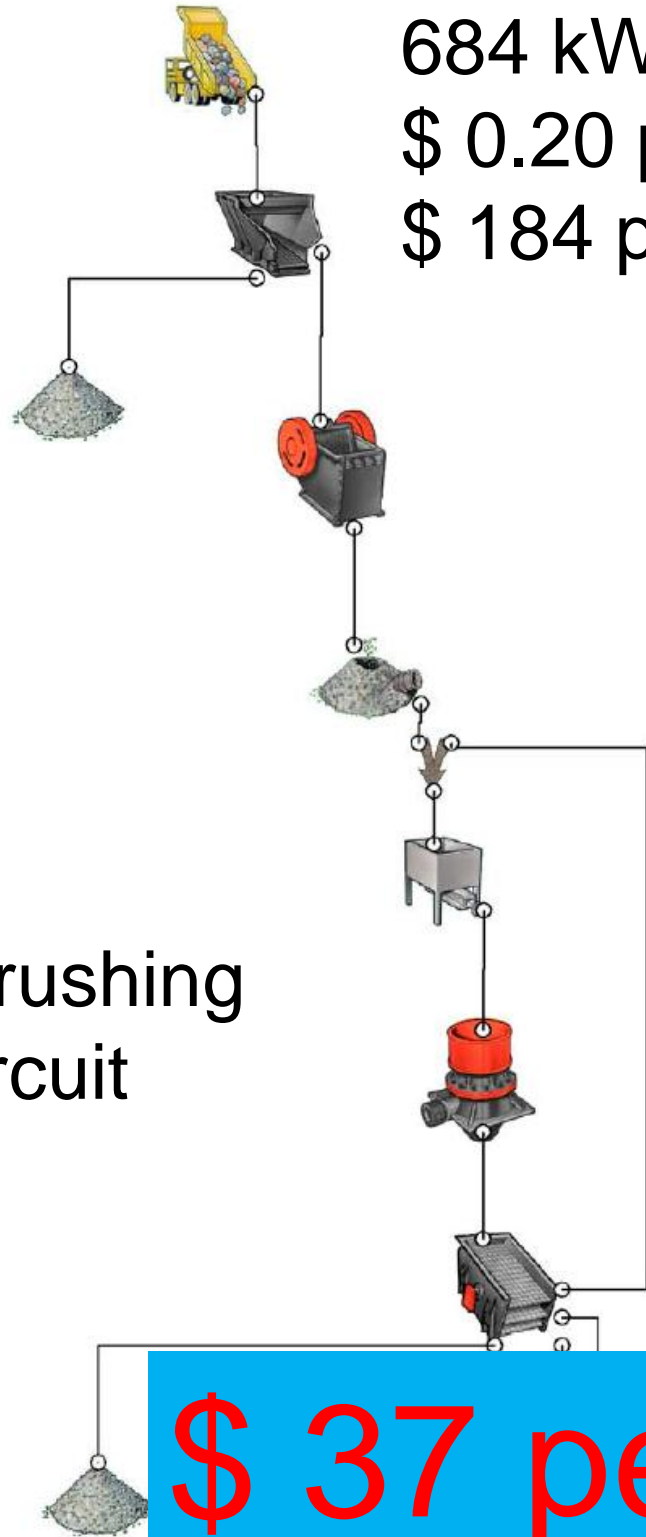


Single stage crushing
Open circuit

350 mtph
385 stph

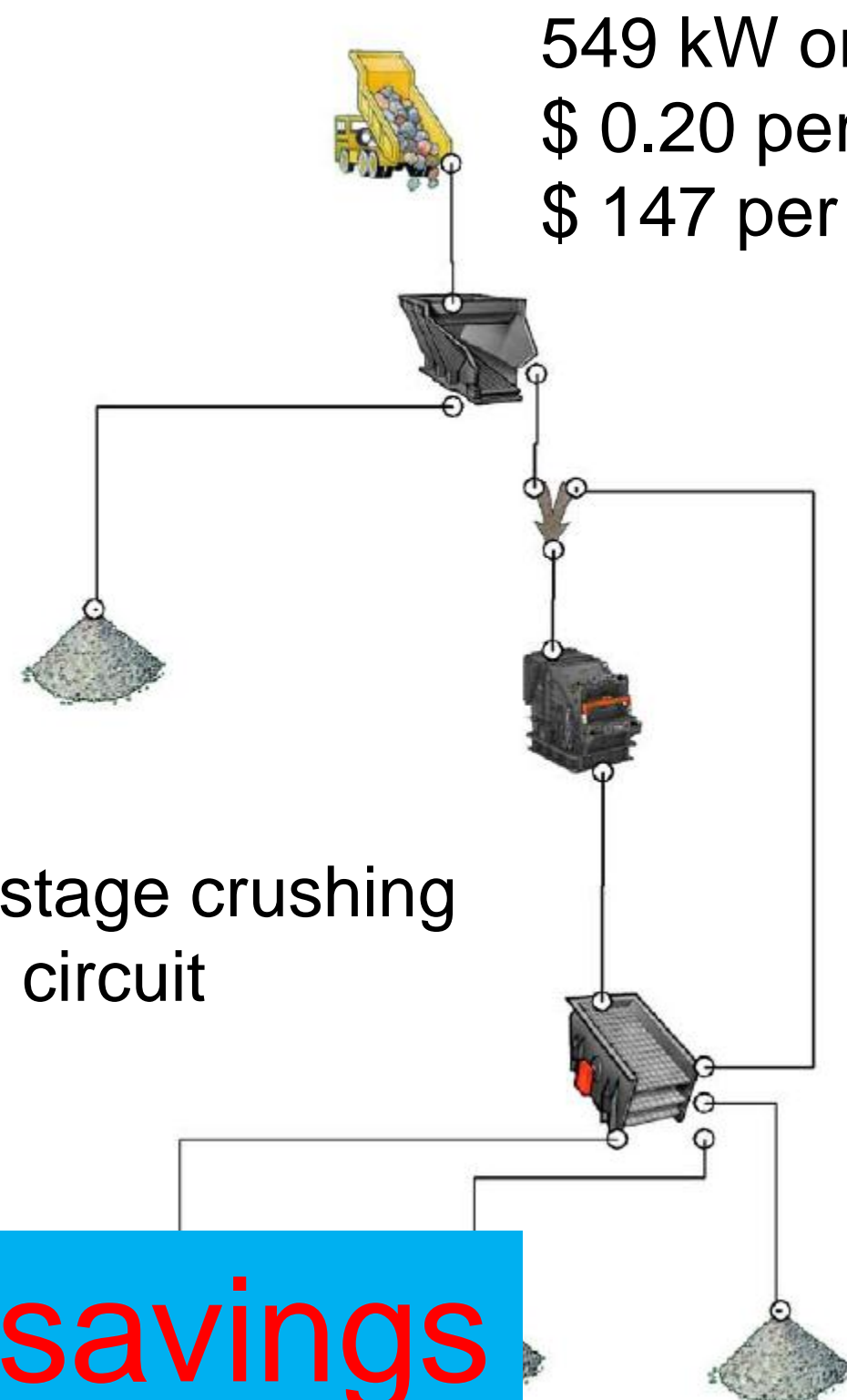
684 kW or 918 hp
\$ 0.20 per hp =
\$ 184 per hour

2 Stage crushing
Closed circuit



549 kW or 736 hp
\$ 0.20 per hp =
\$ 147 per hour

Single stage crushing
Closed circuit



\$ 37 per hour savings

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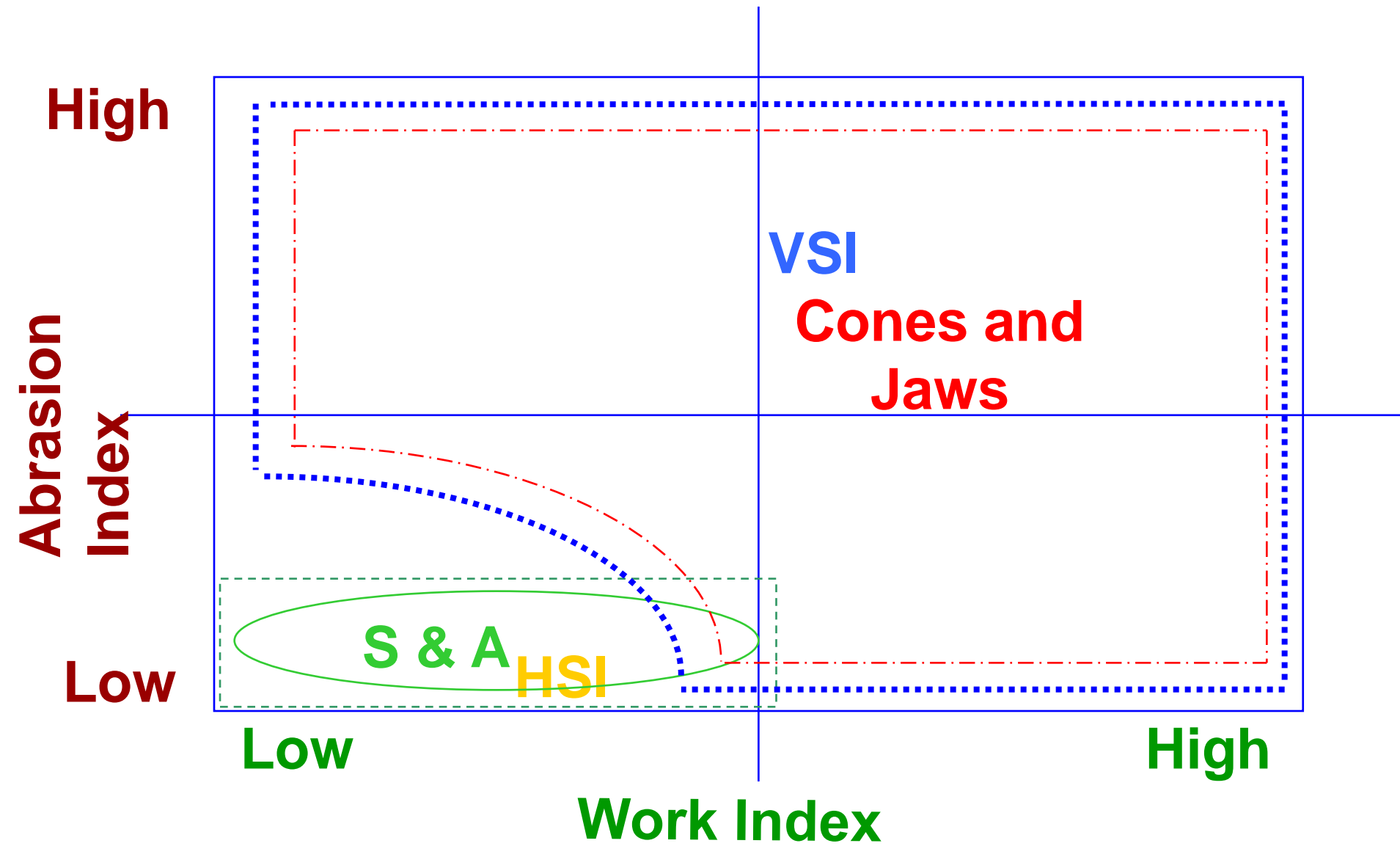
Improving Processes. Instilling Expertise.



VSI Crusher Applications

- Applications (Hard or Soft rock)
- How VSI Autogenous (rock on rock) crushers work
- Manufactured Sand V Natural Sand
- The importance of particle shape
- Other applications

VSI Applications



VSI Crushers

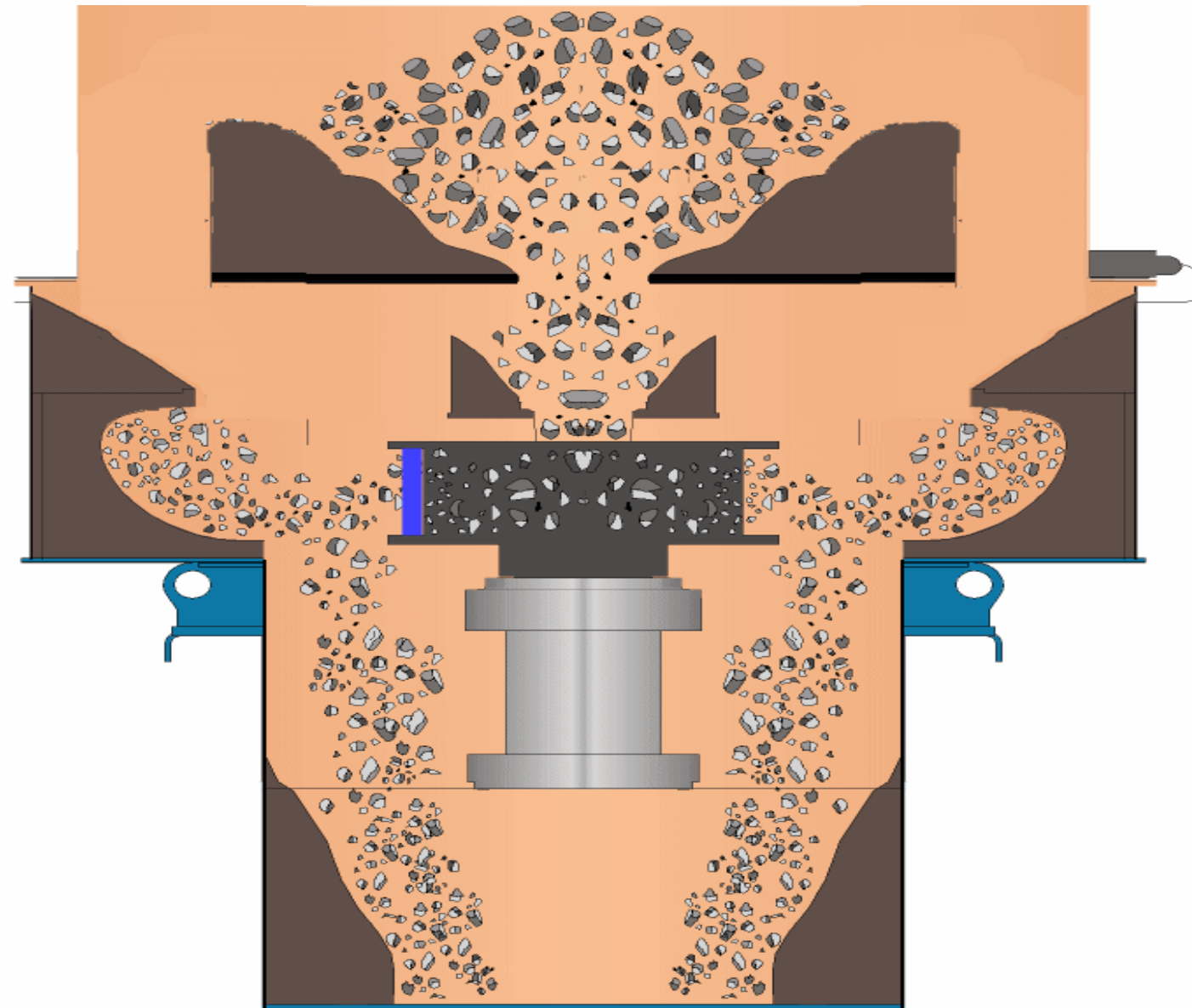
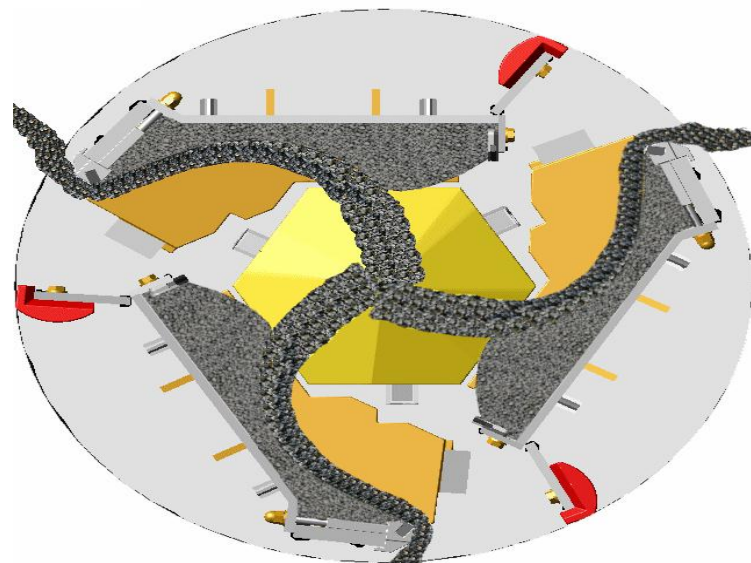
How it works?

- What mother nature achieves over millions of years (weathering, erosion, glacial deposits etc)



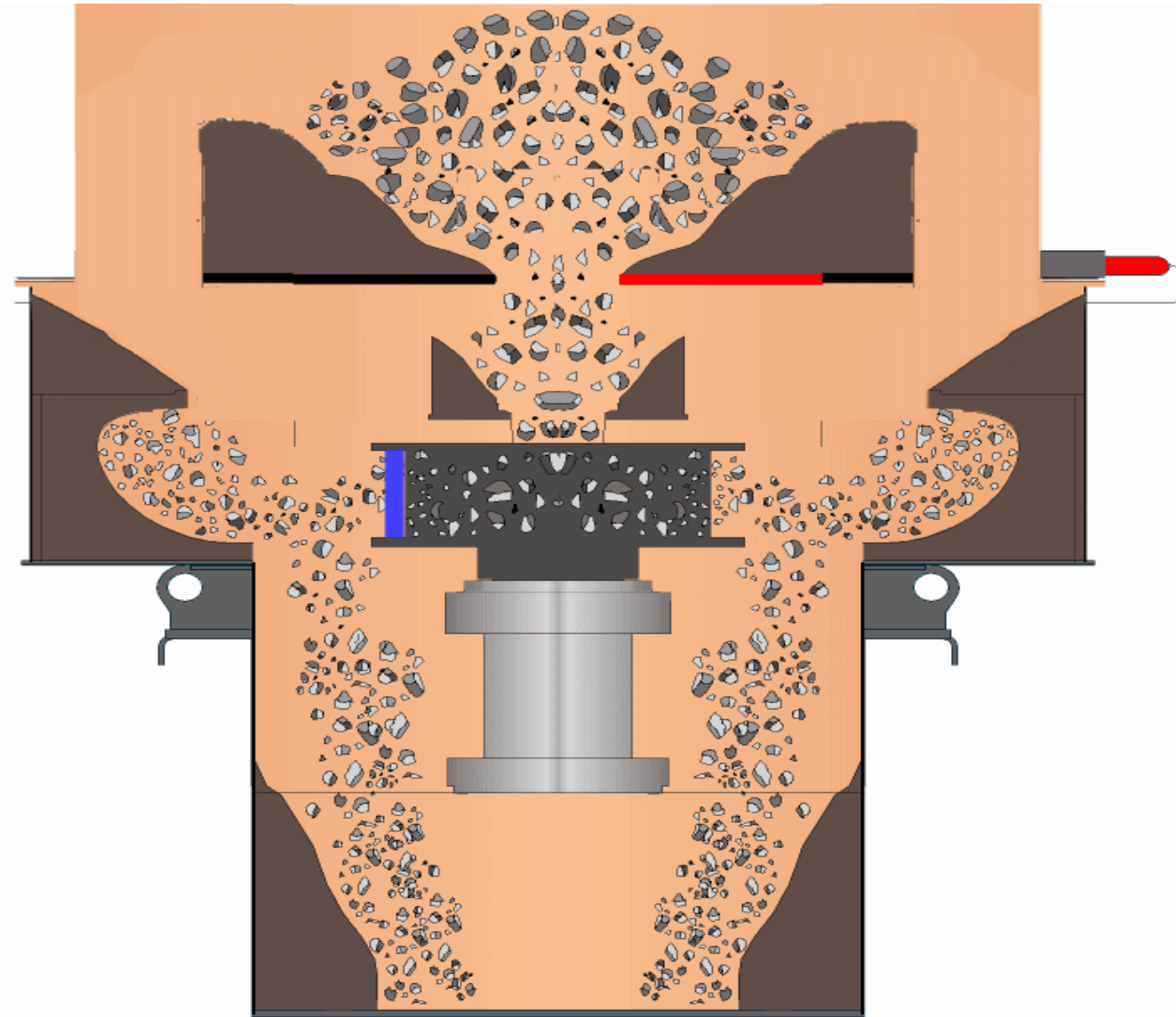
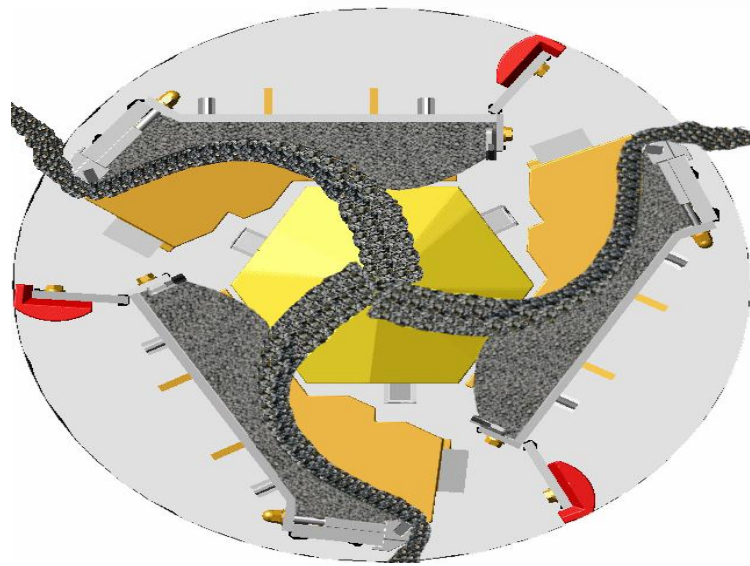
- VSI crushers accomplish in seconds
- A third or fourth stage crusher, that crushes with a “rock on rock” crushing action.
- No wear parts are used to directly “crush” the rock.
- Product gradation remains constant, even when rotor parts wear.

Most VSI's are Rotor feed only



Rotor feed only

Some VSI's do have a secondary feed option

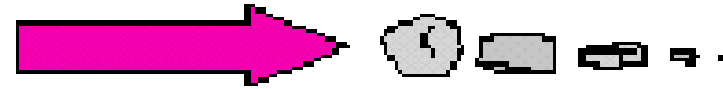
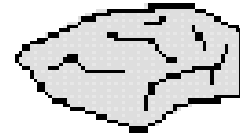


Secondary feed option

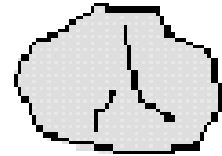
How It Works - VSI Crushing Action

To maximise all 3 types of crushing action listed below which are:-

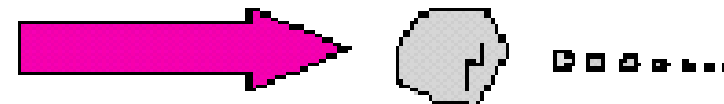
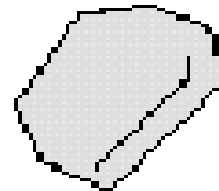
Impact



Cleavage



Attrition



**Operate crusher
at maximum
designed
tonnage
throughput.**

Why Manufactured Sand?



Environmental

- Water table retention and associated lack of planning consents.
- Removal of natural filtration affecting water quality.
- Silt storage and recovery.
- Reduction of stock piles of unusable sand.
- Land re-use.

Economic

- Cost of 75micron (200 mesh) materials removal, storage and disposal
- Reduction in water content
- Reduction in cement content

- End product enhancement
- Increased product strength in concrete/asphalt products
- Improved flow and trowlability

The importance of shape.

Concrete Sand

- Higher compression strengths
- Improved packing density
- Improved fineness modulus (FM)
- Improves flowability.

Frac Sand

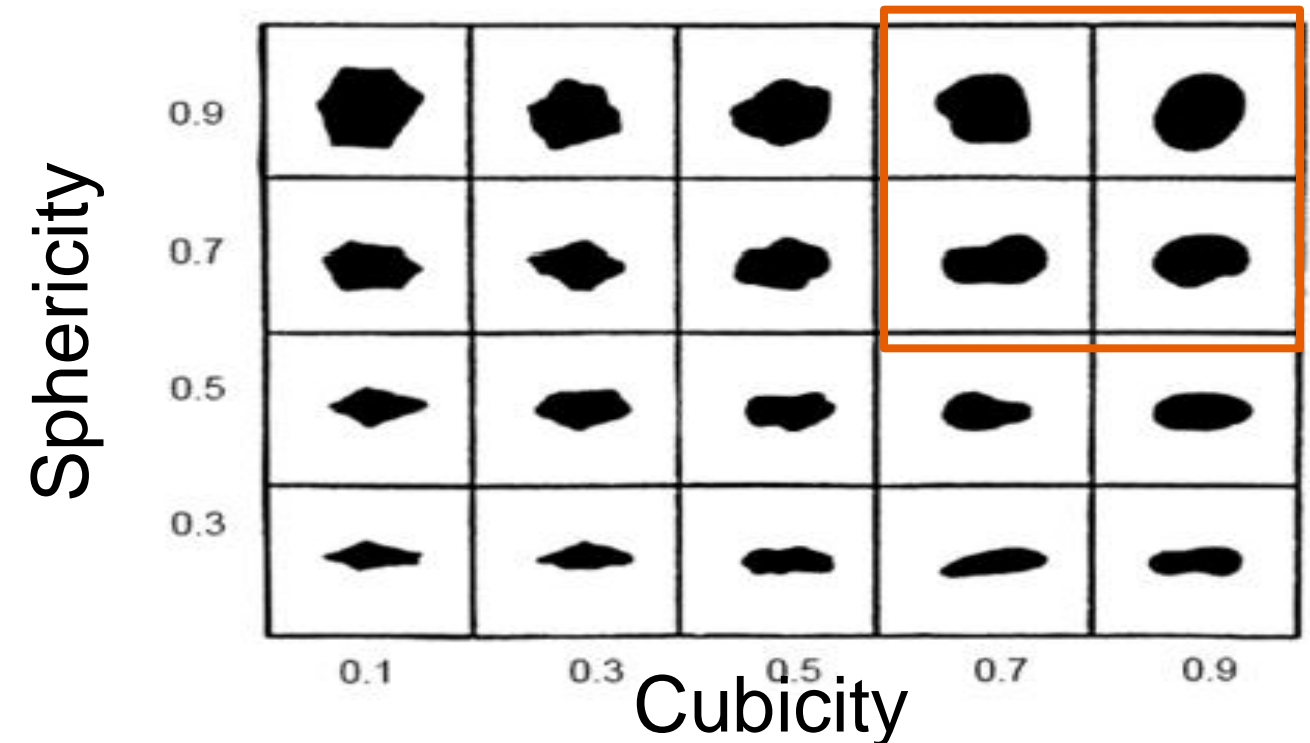
- Shape is of great Importance
- American Petroleum Institute recommends that both roundness and sphericity are greater than, 0.6 when compared to the chart.



VSI crushed material



Compression crushed material



Grain Comparison



Natural Grains



VSI Grains



Comp. Crushed Grains

Material 0,125 mm

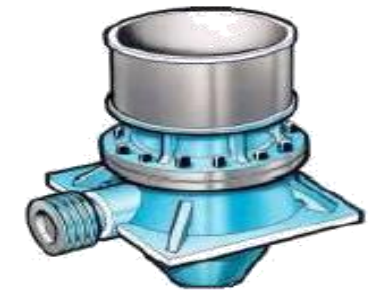
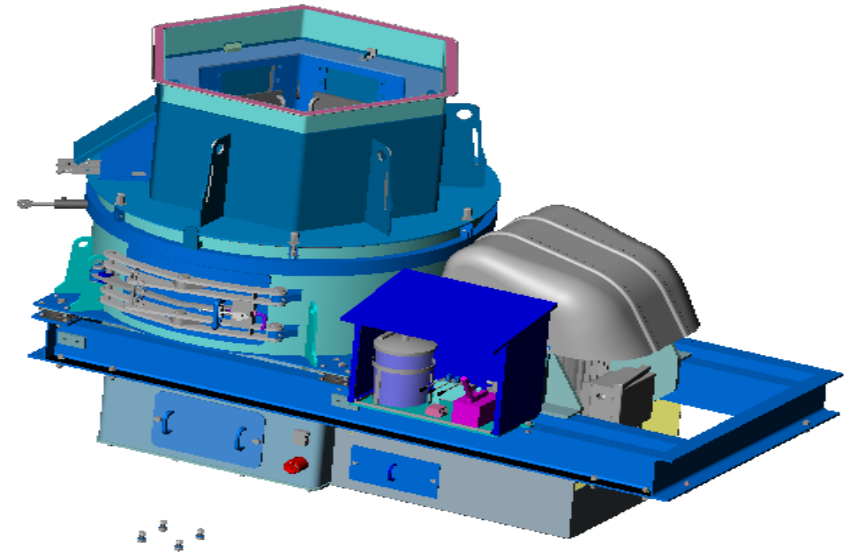
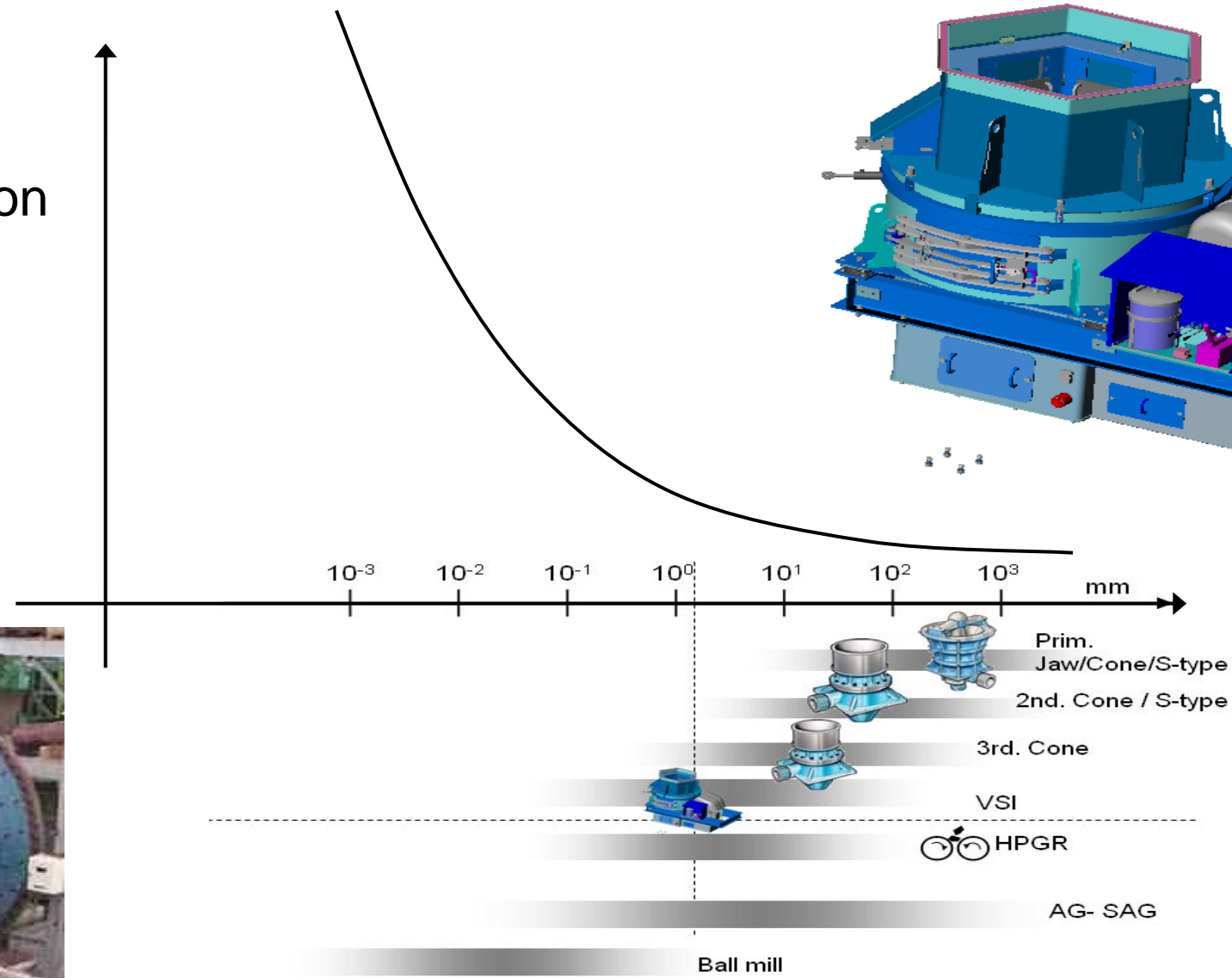
Other applications

Cement clinker Pre-grinding

Iron ore Pre-grinding

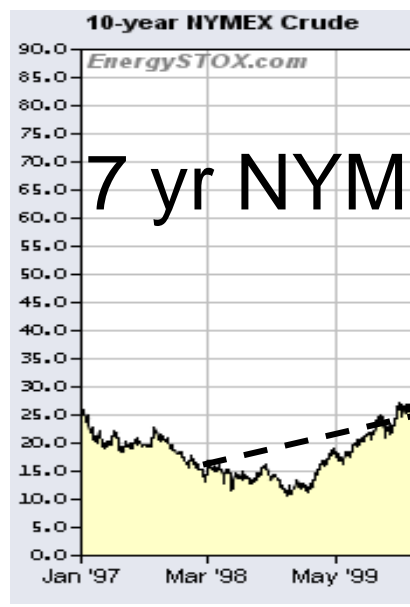
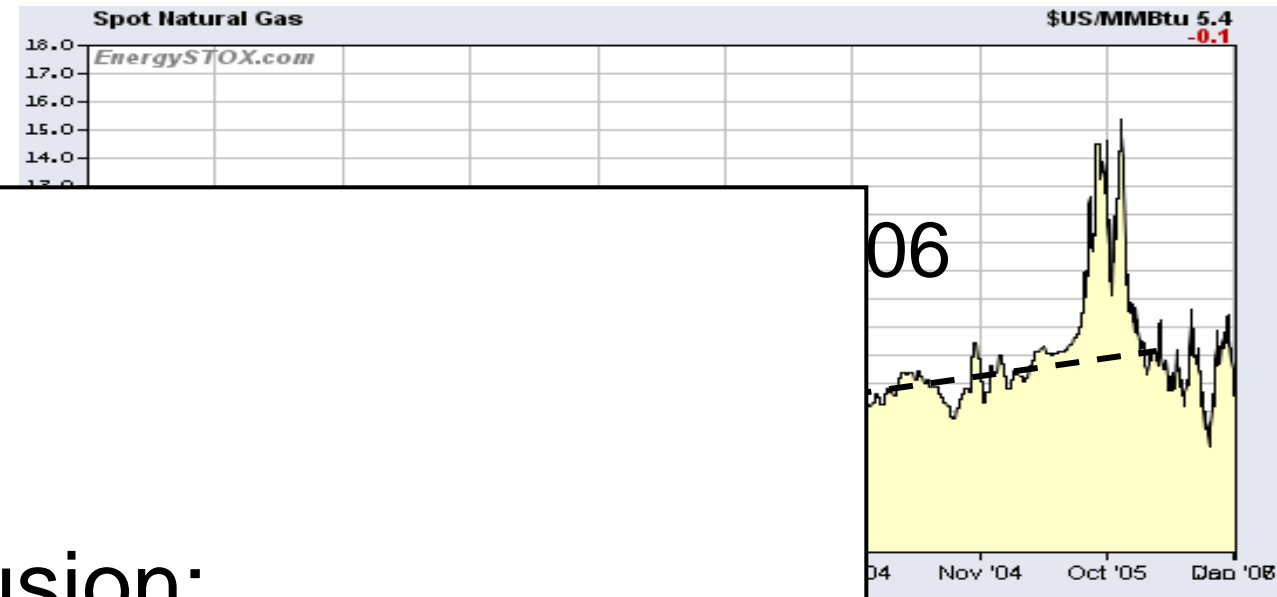
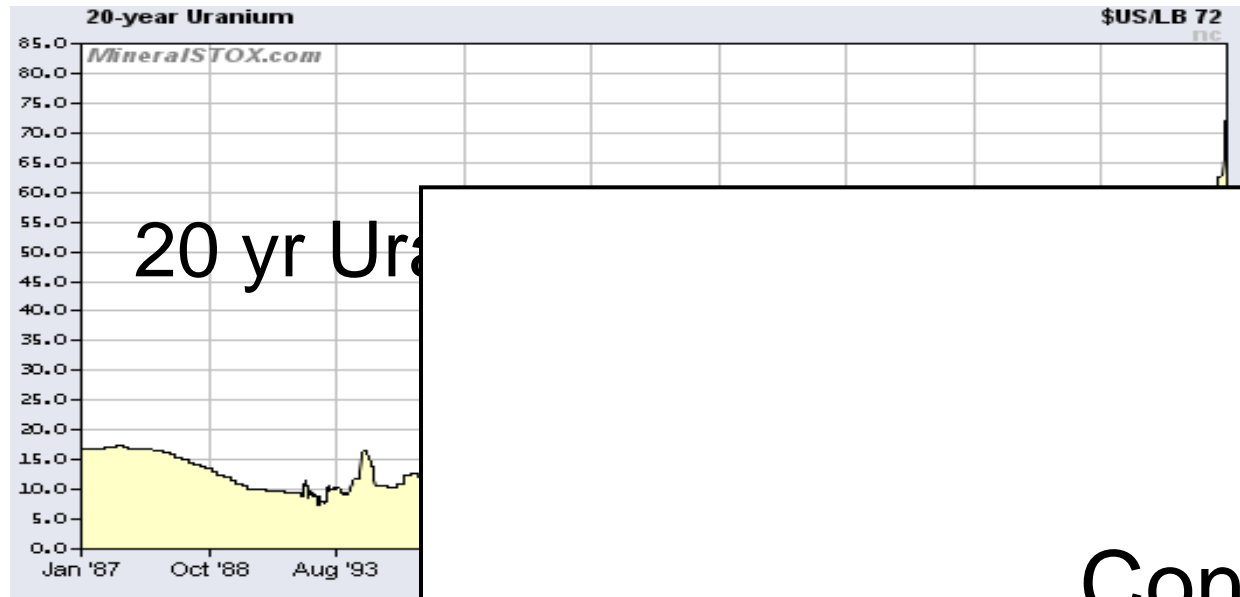


Energy consumption

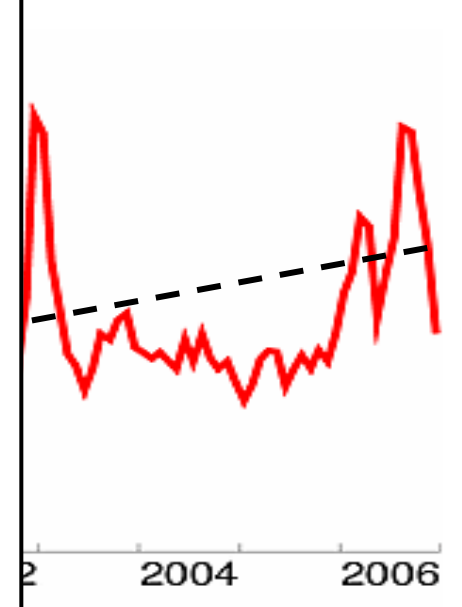


Particle size

We are moving towards a sellers market for many sources of energy!



Conclusion:
Energy conservation will become increasingly important in the future !



Glass recycling



From This



To This

Glass recycling

Crusher, operated in closed circuit @ 3mm, producing product at 80 metric TPH.



Minus 3mm Crushed Glass

Glass Recycling

Some present uses –

- Re-cycle into new glass products, Golf Bunker Sand, Aggregate Sand, Aquarium filtration, Garden Centre weed suppressant, Patio Slab surfacing, Tile Grouting, Children's Play Areas and many many more !!!





3mm Particles, 0.131" 7 mesh.