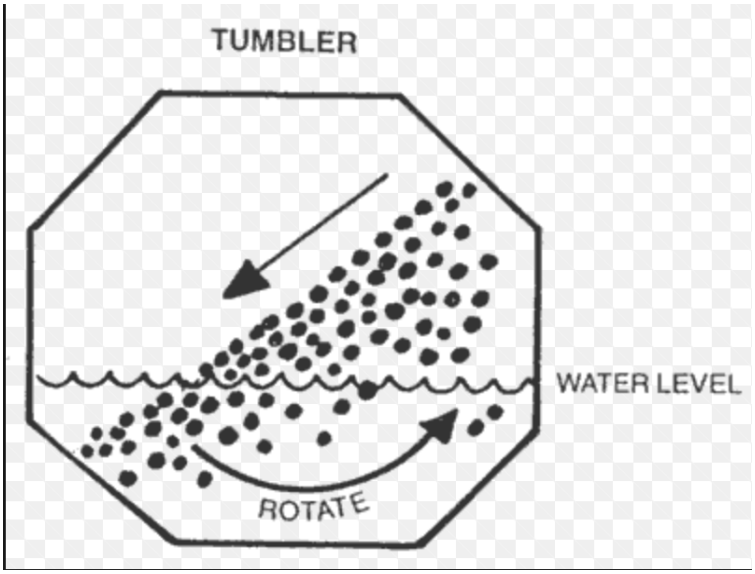
Deburring & Surface Finishing

Vibratory tumblers v/s Barrel Tumblers

Many parts need deburring or surface finishing work. Mass Finishing is used to lower part cost and to create uniformity of finish and to deburr and radius metal components. Two of the more common finishing methods are the tumbling barrel and the vibratory tumbler. The finishing machines are extremely versatile and their applications span across a wide range of industries.

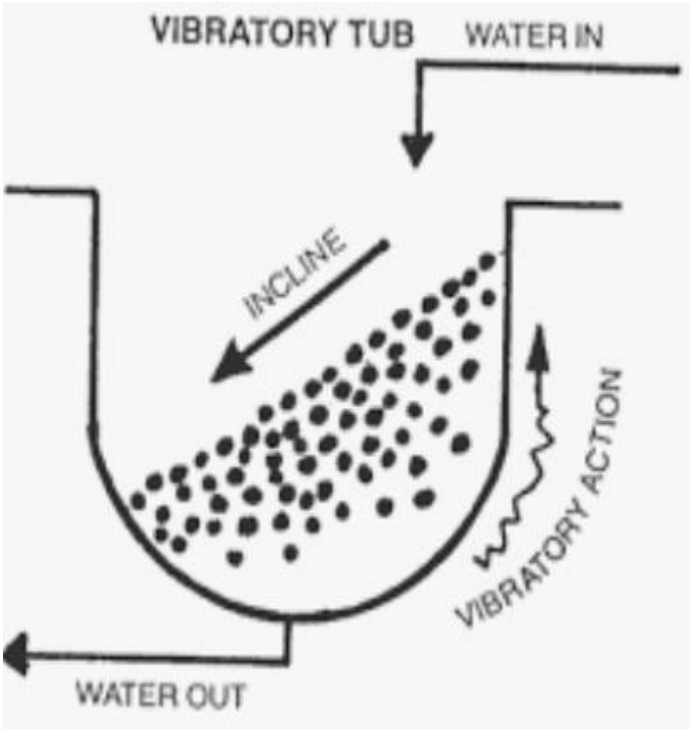
The Barrel Tumbler:

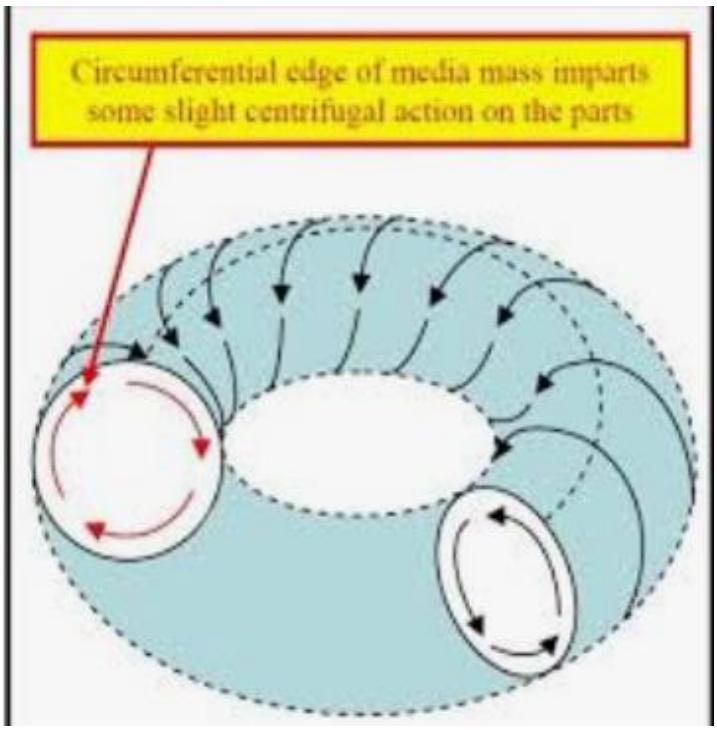
Barrel tumblers have an action similar to that of a rock tumbling and skidding down the slope of a hill. The barrel tumbler's corners lift the load as the barrel rotates until it reaches a point where it slides down the side of the barrel. The parts are abraded and deburred as they bump and scrape against the media and the other parts.



The Vibratory Tumbler:

Vibratory tumblers have an action that is similar to filing. The cutting media surrounds the parts. The eccentric, rotating weight shakes the tub in a circular path during which the entire load is lifted up at an angle and then dropped. As the load is falling (but not actually airborne) the tub returns to an upward position, applying an upward and angular force that causes a shearing action where the parts and media rub against each other.





Cutting Action:

While the barrel tumbler is grinding at an applied force, the vibratory tumbler is moving faster than a free fall. The barrel tumbler's applied force is normally 5 to 10 times the vibratory tumbler's free fall force. In the barrel tumbler, the entire cutting action is restricted to the slide area or 20 to 30% of the total load. In the vibratory tumbler, the entire load is being cut with each pulse, about 1800 times a minute, explaining why the vibratory tumbler has such short cycle times compared to the barrel tumbler.

The parts in a vibratory finishing system are actually moving only about $^{1}/16$" in relation to each other. The parts in a barrel finishing system move across the entire diameter of the barrel. These movements cause large radii to form in a barrel tumbler, but relatively small radii to form in a vibratory tumbler. The tumbling barrel can form a one-eighth radius on a part, while removing very little material from the flat sections. The vibratory tumbler must be set for violent action with large blocky media to produce a sizable

radius, but due to its scrubbing action, it will remove an appreciable amount of material from the flats.

Generally speaking, vibratory finishing systems tend to produce a very smooth flat finish because it really laps the parts. The vibratory tumbler will also cut inside a tube or cup shaped piece, deburring any spot the stone can reach. Since the load is moving as a unit, very fragile parts are quite safe in a vibrator. There is no tearing action or unequal forces that tend to bend and distort parts. The larger the parts or media are, the faster the cutting action. However, the weight of either does not seem to have as much effect as size, since plastic media, 50% lighter than ceramic media, can provide a good cut.

Barrel finishing systems produce a more uneven surface and generally round off corners before deburring much material from surfaces. There are times when this is desirable. For brute stock removal, the barrel tumbler excels. Foundry castings and parts with heavy radii are usually run in a barrel tumbler. The barrel tumbler's peening action can be used to work tougher parts and stress relief machined parts. Hardened and polished steel shot is used extensively in a barrel tumbler for producing a quick luster on parts. While this media may be used in a vibratory machine, the barrel tumbler yields a denser surface and more luster.

Speed and Amplitude:

The speed and amplitude of vibration is variable on most machines. High speeds (1800 cycles per minute) and small amplitudes are used for fine finishes or delicate parts. Large amplitudes are used for heavier cutting, varying the speed according to the finish requirement. High speeds with large amplitudes can roll burrs in and even peen metal into holes and mushroom edges. The circulation of parts is best at higher speeds; therefore, heavy pieces are run best at higher speeds with moderate amplitudes of $^{1}/8$" to $^{3}/32$".

Cost:

Cost is one factor that may decide the choice in some cases. Vibratory systems, due to their massive construction, are much more expensive pieces of equipment. Barrel tumbling systems wear out tumbling media at half the pace of vibratory systems, but have to run longer to do the same job.

Media:

The tendency is to use ceramic preformed media or plastic preformed media in a vibratory finishing system. Ceramic tumbling media is made with abrasive filler, much as a grinding wheel is made. For plastic tumbling media, plastic is mixed with abrasive and cast to shape. Ceramic media uses aluminum oxide as filler and plastic media uses quartz or silica for cleaner results.

Randomly shaped media, either man-made or natural, are rarely used for precision work, because they tend to jam in the holes and do not deburr into corners or recessed areas. When using ceramic media, care should be taken to avoid glazing or loading of

the surface. It is a good practice to run the media with an abrasive grain occasionally to roughen the surface and clean the pores.

Plastic tumbling media is self-cleaning due to its relatively soft bond. Since adding an abrasive to plastic media materially reduces its life, this media should only be used for mild cutting jobs that do not require adding an abrasive to the run. Plastic tumbling media produces large amounts of foam and residue, making it unsuitable for use in an enclosed tumbling barrel. Plastic tumbling media is mainly used for fragile parts or soft metals. Since this media is less than half the weight of stone or ceramic tumbling media, it is safer to use in such cases.

Water:

In both systems, water is added to the load to absorb soils and lubricate the media. To help the water keep the parts clean, chemical compounds are added. An abrasive is sometimes added to enhance the cutting and deburring ability of the tumbling media. Most people assume it is the abrasive that does the cutting, and deburring, but this is not so. The abrasive is used mainly to keep the stone rough enough to do the cutting and deburring.

Much of the finesse of using finishing equipment effectively can only be gained by actually working with the equipment. It is important to keep careful records of each run to learn its effect and also to allow the results to be duplicated later.

Thus, there is no easy answer to the question, "Which system is best?" We have found through many years of experience that to arrive at the proper choice, the particular requirement of the job must be studied and the characteristics of the performance of each system must be known.

Parts Finishing Comparison Chart			
System Type	**Action**	**Characteristic Results**	**Special Comments**
Tumbling Equipment	Rotates loads to cascade downhill.	Large radii. Poor in recesses. Good for large exposed burrs.	Requires good handling equipment. Long cycles.
Vibratory Equipment	Vibrations cause a scrubbing action of media against parts.	Usually small radius (0.010" to 0.020"). Very smooth surface. Very effective in recessed areas. Twice the speed of a barrel tumbler.	Can process very large parts. Lends itself to feed-through automation. Best system for delicate and close tolerance work.

Centrifugal Equipment	Action same as a barrel tumbler, but augmented by centrifugal force.	Results similar to a barrel tumbler, but much faster. High pressure can roll over burrs.	Multiple small barrels require a high degree of handling, but with very fast cutting cycle. Best used for small parts and with small media.
Tumble Blasting Equipment	Parts are tumbled slowly to provide random exposure to a sandblasting gun using an abrasive.	Removes light burrs or texturizes for an attractive finish. Penetrates the smallest crevices and goes through holes to get cross drill burrs.	Performs best with parts around two inches or less. Large heavy parts can be dented. Low labor factor.