

The simplest and most common way of conveying around a corner is with a short radius 90° elbow. If you install one of these in a conveying system the particle traveling down the pipe in a straight line hits the end of the elbow and is redirected, and *not* at a 90° angle. An area of wear is created at the end of the elbow where the particle hits.



The bouncing particles at that point create a great turbulence which slows down the entire mass of material, creating a blockage. Material coming along behind at full velocity hits that slowed down mass of turbulent material and if it is to keep going it will require increased pressure throughout the system. What generally happens is, it plugs. So, with a short radius 90° elbow the problems are: increased turbulence, wearing through the elbow at the impact point, and increased pressure drop, with plugging as the most common single problem.

To relieve the plugging created by short radius elbows the solution would seem to be long radius or sweep elbows. It seems logical that if you take a piece of pipe and bend it so as to make a long sweeping curve, you would eliminate that impact area and a lot of the wear and turbulence because, theoretically, the particles would just slide around the elbow. For pneumatic conveying, this has been for many years, the only acceptable bend. What actually happens is pretty much what happens in the short radius

Taking the technology of particle conveying out of the stone age.

By the HammerTek Corporation

HOW DO IT WORK?



elbow. Particles coming down the pipe go in a straight line until impacting on the outside radius of the elbow in an area about as big as the pipe diameter, then bounce back, bouncing again and again, creating an area of turbulence, slow down, and abrasion. Also, in a



sweep elbow, material sliding along the outer wall creates friction, and that friction generates heat, making the pipe surface very warm. If you are conveying plastic pellets, the heat of friction will actually melt the edge of the pellet. The melted part of the pellet will adhere to the pipe, while the mass of material pushes the pellet along, leaving a streamer behind, much as if you had stepped on a piece of chewing gum. As you pick up your foot, you create a long string of chewing gum that is adhered to the ground. In this


case, it would be a long string of plastic adhered to the pipe. There is also an extended area of turbulence as the particles bounce back and forth. The turbulent material slows down, material coming along behind hitting that slowed down turbulent area also slows down. Creating, again, a rise in required pressure and more horsepower, but in many cases it will plug. So, there is a broad wearing area in the impact zone, a turbulent area which is prone to plug, and if you are conveying plastic pellets, you may get streamers, or stringers, or you may damage friable materials. Long radius sweeps require a lot of space for installation, and take considerable engineering design and layout time. So the sweep elbow is not the optimum answer.




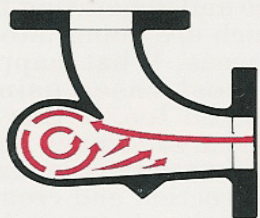
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Somewhere between the short radius 90° and the long radius sweep elbow is the plugged tee. In use, a standard tee fitting is put into the line, one end of which is plugged, so that material comes in from one side and goes out the center of the tee, leaving the end that is plugged to fill up with material. Conveyed material compacts in that area and material conveyed down the pipe impacts on that compacted material. There is no wear on the end of the fitting, obviously. However, there is a bounce back of material which will wear the extremity of the tee and sometimes the adjacent pipe. So, again, bouncing material, creates an area of turbulence and wear.

If, indeed, a process cannot tolerate fines, there is a compounded problem, because the material coming down the pipe and changing direction against that compacted plug of material is continually abrading the surface and generating fines which are going into the process. What happens in most cases using a plugged tee, is that the filled area is much larger, backing across the change of direction and creating a restricted area right at the angle of turn. Material arriving at that point slows down, creating turbulence, and again, increasing the pressure needed to maintain the required rate of flow. Another problem with plugged tees is, if they are in a process that requires material changes, but which cannot tolerate cross contamination, they are almost impossible to evacuate completely, so that you almost have to take them out of the line and clean them as you change materials. So, they too, are not really the answer, and they do create some unique problems of their own.

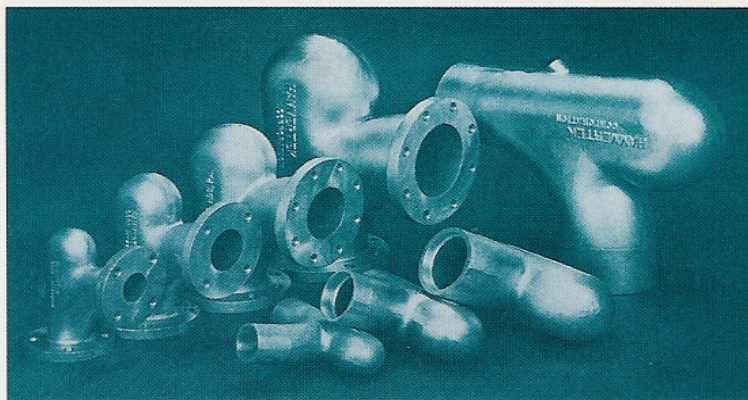
 We have discussed three types of elbows, a short radius 90°, where the particles impact on the end of the elbow. Then a long radius or sweep elbow where the particles impact into one area and then slide along and bounce back and forth through a long area. Then the plugged tee where the material hits into a compacted mass of itself and bounces back from that. None of these work well, they all create turbulence, they all create increased pressure drops and they all create wear in the fitting at various points.

 **SMART ELBOW®**—an actual breakthrough in technology. The functioning, mathematics, and mechanics, of this elbow are entirely different from all of the others. A cross-section view shows that the end chamber is nearly spherical in shape.




The positioning of this chamber in relation to the pipe to which it is attached is a critical design feature. You will notice, that when mounted on a perfectly horizontal pipe, the entire fitting assumes a slightly downward slope. The chamber itself is then offset from the center line of the incoming pipe. This means that the center line of material and air entering the chamber is above the cen-

NOW, A BREAKTHROUGH!




ter line of the pipe. The shape and location of the chamber forces the material to assume a downward rotation. Since it is ball shaped, there is a slight kick-up area at the bottom which forces the material back up toward the top again, starting a rotation that actually forms a loose rotating ball composed of particles suspended in air within the chamber. The curved upper surface of the chamber located and protected as it is, works much as the wing of an airplane—it exerts a downward force on the air passing underneath it, helping to drive the material and air around in a circle.


 The best way to describe what drives that slowly rotating ball would be to imagine a bicycle turned upside down with the wheels in the air. If you were to squirt a garden hose directly at the center of the tire, nothing would happen. If however, you raise that stream of water slightly above center, the wheel would start to rotate. If you raised it higher, the

wheel would rotate faster. That is, in effect, what is done by the positioning of the chamber in relation to the center line of the pipe. The major impact zone is controlled so that the ball revolves very slowly. Remember, this is a ball composed of particles of material suspended in air. Obviously everything can't get into that chamber and rotate, so a good portion of the material that comes around off the bottom is projected up and out and it impinges on, the incoming stream of material suspended in air, thereby deflecting most of the incoming material around the elbow.



So, material coming into this chamber forms a very loose slowly rotating ball of material suspended in air, and this material rotating and coming off the bottom deflects the majority of the incoming material stream around the corner.

 The principle that is working here is entirely different from the principle in the short radius ell, or the long radius ell, or the plugged tee. We are not depending on a wall or a compacted mass of material to deflect the stream of particles. Those particles are deflected by a mass of material suspended in air. There is, in effect, *no impact zone*. We have removed the wall. This effectively eliminates the areas of wear created by impact, friction and turbulence. It also eliminates the heat generated by friction, thereby eliminating streamers and product damage. Also, by doing it this way, we eliminate all of the turbulence that is generated by particles impacting and bouncing back and forth. This serves to smooth out the flow, requiring less energy to maintain the required rate, and it will *not* increase the pressure drop.

 So, now you not only know how it works, but you know why it is so different that it has been patented. And why we can guarantee it.



One SMART ELBOW® installed in any system will quickly show you the difference.

