Applying Pressure to Tame Problem Parts

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A manufacturer of pinion gears required a near-white-metal finish on steel billets being fed into a high-production forging process. Averaging 3 inches in diameter by 5.25 inches in length, the parts had to be cleaned at a rate of 5 feet per minute, non-stop, during 20-hour-per-day production cycles.

Surface conditions on the first billets tested in Empire's lab ranged from light rust to moderate scale, all of which had to be removed. Thorough cleaning was essential to prevent surface residue from embedding into finished parts and/or damaging very expensive forging dies.

Abrasive blasting was an obvious cleaning method for this application but developing the right machine for the job posed a few challenges. For starters, the entire circumference of each billet had to be cleaned, which ruled out the use of fixtures that would mask even a small area of the part. So rather then going to the expense and complexity of multiple fixtures, we developed a linear-feed conveyor with no fixtures. The billets instead rotated on two slightly skewed rollers within the blast envelope while moving through the blast enclosure. This unique technique of moving and rotating parts on the skewed conveyor assures complete blast coverage while providing the flexibility to handle parts of different sizes. In addition, the system could be interfaced with the customer's drop-on/drop-off conveyors to smoothly transfer work pieces to and from the blast enclosure.

The second constraint was compressed air. Our machine would have to operate on a diet of approximately 340 SCFM, which, according to our preliminary test results, could be accomplished with either a suction- or pressure-blast system. Using suction, however, would save the customer about 25% in terms of initial equipment costs, primarily because suction systems rely on less hardware when used in a continuous-duty application. Consequently, we proposed an arrangement of 8 fixed suction-blast guns with 5/16" nozzles consuming approximately 310 SCFM of compressed air when operating at 80 psi – the blast pressure required to assure thorough cleaning of the dirtiest parts we had processed at a feed rate of 1 inch per second.

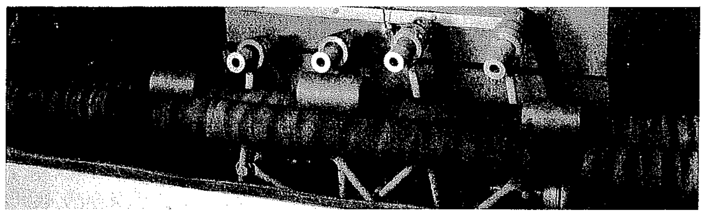
Our tests demonstrated this system would provide the customer with a safety margin of about 10% on compressed air, which would have been adequate – until we received an update from our regional representative. He explained that the customer might be processing larger and dirtier parts in the future and wanted to know how we could provide sufficient reserve capacity to meet these contingencies. With our safety margin shrinking, and larger challenges looming, we turned to the heavy hitter. It was time to apply pressure.

It's no secret that pressure-blast systems use compressed air more efficiently than suction systems. With suction, up to one-half of the system's energy can be expended just pulling abrasives into blast guns. Also with suction, acceleration of media as it travels through the feed line is negligible. Pressure systems, on the other hand, speed up the flow of abrasives continuously as they move through the feed line, resulting in a higher outlet velocity per pound of operating pressure. Going back to basic physics (Energy = 1/2 Mass x Velocity Squared), we see that doubling the velocity of an abrasive particle quadruples the energy it has available to perform work.

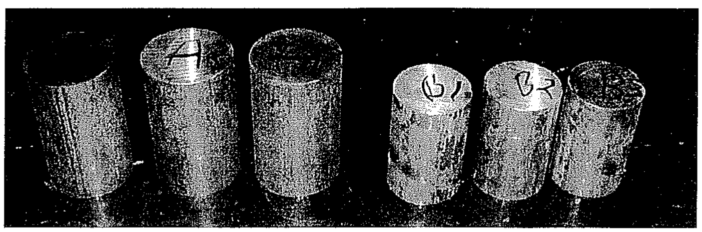
Our second system proposal, based around a pressure system, serves as proof of the pudding. With pressure, four blast nozzles operating at 30 psi were able to do the work of 8 suction guns operating at 80 psi and air consumption plummeted to roughly 200 SCFM, a decrease of over 30% compared to the suction system. Besides reducing utility costs, the use of pressure provided the customer with a comfortable safety margin for increasing future production rates. By simply adjusting blast pressure up to 50 psi, the work performed by the system could be increased by over 60% without exceeding the customer's compressed-air allotment of 340 SCFM. And if production demand really skyrocketed, system capacity could be more than tripled with a larger source of compressed air.

Although initial cost for the pressure system we proposed was about one-quarter higher than for the suction system, the long-term benefits of lower operating expense and reserve capacity for future expansion persuaded our customer that pressure was the right choice.

Empire's blast systems are used in a wide variety of cleaning, peening, profiling and finishing operations. The company also produces blast cabinets, blast rooms and portable blasters. For more information on Empire's automated systems, contact Jerry Conover at 215-752-8800, extension 306 or E-mail (jconover@empire-airblast.com).



To eliminate the need for special fixtures and assure complete blast coverage, Empire developed a skew-roller conveyor for use in the customer's automated, in-line production process.



Billets on the left with light rust and moderate scale could be cleaned to a near-white-metal finish with either a suction or pressure system. Billets on the right with heavier scale, added to customer requirements for expandable blast capacity, indicated that a pressure system was the preferable choice.