FIG. 1—Macrophoto of Cutwire shot taken from a production shot blasting machine, showing uniform size and shape of the particles after considerable use.

CUT WIRE SHOT

Lowers Cleaning and Peening Costs

Users of this new material report reductions of as much as 50 pct in peening costs and 30 to 80 pct in cleaning operations. Other savings come through increased fatigue life and higher permissible working stresses on the parts.

THE growing popularity of blasting with metallic shot or grit stimulated widespread interest in the importance of shot and grit quality and its effect on blasting conditions. In the search for superior results, users of the method have resorted to glass beads because of their roundness, forged steel balls for soundness, walnut shells, and many other varieties of blast materials. It was generally accepted that a wrought metal shot would have qualities more suited to the abusive treatment of shot blasting.

As early as 1946, a form of shot had been made by cutting steel wire into short pieces. The shot proved excellent in use, but the method of manufacture was prohibitively high in cost. A little over a year ago, the new technique of cutting wire into diameter lengths was developed, employing a high speed rotary shear principle, by means of which multiple wires could be cut into accurate-sized shot particles at a reasonable cost.

These particles have inherent properties that make them ideally suited for the majority of shot blasting operations. A principal feature of the shot is its high physical properties. Cutwire shot is manufactured from high carbon steel spring wire having a tensile strength of 250,000 to 310,000 psi, depending on size, and high resistance to fatigue failure from impact.

In use, the shot rapidly rounds into hard, uniform-sized spheres (Fig. 1), making it an ideal blast medium for shot peening applications. Its long shot life has in some instances, reduced peening costs by as much as 50 pct. Due to this same long life, Cutwire shot has reduced the cost of shot cleaning forgings and castings in a number of plants by 30 to 80 pct.

The general method of shot cleaning or shot peening consists of blasting a continuous stream of shot against the workpieces. In cleaning, the high velocity shot particle strikes the work and dislodges the sand, scale, etc. In peening, the shot particle strikes the surface of the work and causes a slight permanent set at the point of impingement. The result of a complete coverage of the part by a peening blast is to establish a compressive stress in the outer layer of the part.

In both cleaning and peening, after the shot has struck the work it is quickly recovered and recirculated through the equipment to be re-used. As each shot particle strikes the work at high speed many times per hour and as there are millions of particles involved in any piece of blasting equipment, it is expected that many of the shot particles will be worn out or broken each minute. A shot with a high tensile strength maximum fatigue life, high hardness, and proper shape is therefore desired.

Cutwire shot is now being made from carbon steel wires of an analysis comparable to SAE April 6, 1950
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1065 and so are heat treatable. By the proper balance of heat treating and cold working from the drawing operations, wire is being produced for shot purposes that has tensile strengths in excess of 250,000 psi, hardnesses of 48 to 52 Rc, high ductility, and long fatigue life. Due to the inherently accurate method of cutting the wire, the size of the particles varies less than 1 pct avoiding any problems of shot size control.

Tests of Cutwire shot in conventional shot testers which simulate the striking conditions present in production blasting equipment consistently show it to have an average shot life hundreds of times better than the bulk of shot now being used for blasting, as shown in Fig. 2. Because Cutwire shot can be made from various wires, any desired properties can be attained. Shot having a hardness of 60 to 62 Rc has been made, as well as low hardness copper shot. Because of this engineered shot, new uses for shot blasting are being discovered.

If shot blasting equipment is in good condition, no alterations are necessary to utilize Cutwire shot. Excessive leakage or waste of shot is a common trouble with shot blast equipment. No machine with excessive loss of shot is economical to operate with any shot. When leakage is nominal so that the long life of Cutwire shot can be fully utilized, there is usually a major saving in cost through reduced shot consumption.

Tests in production machines have shown a reduction in shot consumptions of from 8 to 1 to 20 to 1. One outstanding machine showed a reduction of more than 100 to 1. It had been using 6000 lb of chilled iron grit per 80-hr week; the same production has been maintained, using less than 60 lb of Cutwire shot per 80 hr week, for more than 3 months. The performance of one such machine is given in Table 1. These savings are typical of cost reductions in peening applications using Cutwire shot. The machine is peening front suspension coil springs in a large automotive plant.

This represents a shot consumption reduction of from 25 lb per wheel-hr with the previous shot to 3.1 lb per wheel-hr with Cutwire shot. Other applications of peening with two-wheel blasting machines on like parts have shown consumptions of the new shot to be 2 to 2.5 lb per wheel-hr, and as low as 0.4 lb per wheel-hr in an exceptionally well-operated machine.

Similar savings have been reported in cleaning operations as well. A production foundry made comparisons on a high production, multiple wheel blast cleaning machine, and found that shot consumption per wheel per hour had been reduced from 39 lb of the shot previously used to 2.5 lb of Cutwire shot. Wear life measured of the wheel blades was increased from 36 hr with the previous shot to 88 hr with Cutwire shot. Other machines, all using in excess of 25 lb per wheel-hr of previous shots, reported reduced consumption of 1.6, 2.1, and as low as 0.25 lb per wheel-hr of the new material.

Cutwire shot in use forms rapidly into spheres and as such flows easily through the shot blast equipment. These round particles are extremely efficient for cleaning; their hitting power remains at maximum, as the shot does not easily break down in use. A graphic illustration of this is shown in photographs made with a standard shot classifier, Fig. 3. The classifier consists primarily of two plates of glass set apart on a slight taper. Shot dropped into the opening between the glass plates falls and wedges at a point marked with its corresponding size. The size distribution is recorded by taking a photograph through the two sheets of glass against a white background.

The wear on component parts of the machinery is greatly reduced through lack of sharp edges. As maintenance costs constitute more than 30 pct of the cost of operating such processes, a reduction in maintenance is of vital importance. Production records show that, where Cutwire shot has been used, maintenance on equipment has been reduced from 15 to 40 pct, as shown in Fig. 4.

Screened samples of shot from production machines show over 80 pct of the shot to be within 0.003 in. of full size and that less than 5 pct is below 50 pct of full size. In cleaning operations, this allows for rapid and complete separation of sand and scale particles from the blast stream;
they are so much smaller than the shot particles that the danger of removing usable shot with the refuse is negligible.

Because of uniformity of the blast stream and its constant cleaning ability from day to day, the cleaning cycle time approaches a constant for similar parts. This enables the machine operator to blast to a standard time and eliminates much of the overblasting that now takes place "just to make sure."

Installations of shot blasting using Cutwire shot for the cleaning of forgings have shown a substantial saving in cost over good pickling practice. Good pickling practice costs range from $1.20 to $3.80 per ton cleaned whereas Cutwire shot can be realized in addition to process cost savings. Coil springs that are being peened with Cutwire shot have had such an increase in fatigue life that higher working stresses have been possible resulting in lighter springs to do the same job. Weight reduction and resultant material savings alone are saving the cost of the peening operation on this spring.

Future uses of shot blasting has been expanded by the advent of this new shot. The low cost of shot cleaning and shot peening will create many new applications in fields where it had not been previously considered economical. Two major fields of application already opened are the economical substitution of shot cleaning for acid pickling in a number of cases and the economical shot peening of parts for a reduction in weight, made possible by increased fatigue life of the part.

By using Cutwire shot in good equipment, savings in production costs may be realized without expenditures for new equipment or alteration of present installations.