journal of engineering for industry

discussion

Effects of Built-Up Edge in Drilling[1]

C. J. Oxford, Jr.[2] Professors Dolodarenko and Ham have presented an interesting extension of the work I originally presented in 1953 (authors' reference (*1*)). While the paper is relatively short, I would like to point out that every data point on the numerous graphical figures represents a great deal of complex work in specimen preparation and measurement.

In reading the paper, I was first struck by the relatively large built-up edge (BUE) formed under drilling conditions which were really quite similar to those we used. The fact that we used 19-mm rather than 13.5-mm drills hardly offers an explanation. However, a check of our records has yielded what may be a plausible explanation. The taper shank drills we used were black oxide treated in dry superheated steam, while the drills we furnished to the authors were screw machine length drills which have bright finished flutes with no surface treatment.

Some time ago, we conducted some friction-wear tests which ran a number of work materials against bare high-speed steel and the same HSS with a variety of surface treatments. When run under various loading conditions, with and without lubrication, the steam oxide treated HSS always delayed the onset of galling by a factor ranging from 10 to more than 100 as compared with bare HSS. Thus, the oxide treatment is a very powerful anti-seize and this may well be an important factor in the difference in BUE size encountered under the two drill test conditions.

I have some reservations about calling the slip plane between the chip and the BUE a "real" rake face. Certainly the blunt nose of the BUE would not make for very efficient cutting, and in some regions along the drill lips additional energy is required to deflect the chip so that it will flow along the drill flute faces as shown in some of the photomicrographs of the authors' Fig. 3.

The presence of a BUE is seldom troublesome in drilling except when an attempt is made to produce good hole wall finishes in mild steels. Both drill surface treatments and the use of cutting fluids tend to suppress the formation of a large BUE, and both are general in production drilling of ferrous materials. Examination of dull drills usually reveals appreciable crater-like flute face wear adjacent to the cutting edge; this is not consistent with the presence of a permanent BUE. The transient nature of the BUE may be the major reason for the large discontinuities indicated in the author's plots of "real" normal rake angles, Figs. 8–11.

Much more experimental and analytic research will be required before we can really understand all of the complexities of twist drill operation and I hope that the authors and their associates will continue their work in this area.

Author's Closure

The authors wish to thank C.J. Oxford, Jr., for his pertinent discussion and suggestions. His observations on possible causes of excessive BUE in our case are interesting and aid in understanding of the differences with his previous test results. The authors certainly agree with his recommendation that much more experimental and analytical research will still be required to understand the complex operations of drilling. Again, we would like to express our sincere appreciation to Mr. Oxford not only for his assistance in providing his test equipment and test drills, but also for his comprehensive discussions.

[1] By A. G. Dolodarenko and I. Ham, published in the Feb. 1976 issue of the JOURNAL OF ENGINEERING FOR INDUSTRY, TRANS. ASME, Series B, Vol. 98, No. 1, pp. 287–292.

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