Effect of temperature and flux concentration on soldering of base metal.

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Abstract

The present study used the acoustic emission (AE) technique to evaluate interactions among soldering temperature, flux treatment, and the resultant ultimate tensile strength (UTS). Scanning electron microscopy (SEM) was used to examine fracture surfaces of the solder joints. Specimens were cast from removable partial denture alloy and then placed in a jig with a gap distance of 1.0 mm. A high-frequency soldering machine with an optical pyrometer was used for soldering at 1150 degrees C and 1200 degrees C, respectively. The flux concentrations were 67% and 75%. The soldered specimens were subjected to tensile test at a crosshead speed of 0.05 mm/min. During testing, acoustic emissions in the frequency range of 100--1200 kHz were collected, filtered, recorded, and processed by a sensing device. The results were analysed by ANOVA and Tukey LSD test. UTS at different temperatures showed no significant difference according to either mechanical or acoustic results. But in the 1200 degrees C group, the UTSs and AE counts showed significant differences ($P<0.05$) at both flux concentrations. SEM showed that the 1200C group had better dendritic crystal structure than did the 1150 degrees C group. In the 1200 degrees C group specimens with 67% flux had fewer flux inclusion bodies and dendritic crystals than did specimens with 75% flux. The 75% flux subgroup produced high-amplitude (60--70 dB) acoustic signals within the elastic deformation zone, while the 67% flux subgroup produced similar signals within the plastic deformation zone, either beyond the 0.2% yield point or before fracture.