ABSTRACT

Effects of Ceramic Abrasives on Millscale Removal and Base Metal

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The effectiveness of three abrasives on the removal of high temperature iron oxide (mill scale) was determined in terms of abrasive coverage (defined as the area of mill scale removed in a given blasting time), the size, shape and mass flow rate of the abrasives and process parameters such as nozzle size, nozzle to part distance and air pressure. The abrasives used were industrially available blasting material – silica sand, abrasive bauxite and Black Beauty, the latter being a glass making slag with about 50% silica and up to about 30% aluminum oxide. The Black Beauty was generally angular and sharp whereas the silica sand and bauxite were more rounded. The nozzles used were 3/16, 1/4 and 3/8 inch diameter, the nozzle to part distances were 4, 10 and 20 cm and air pressures of 90 to 130 psi. The closed blasting chamber used for the experiments was designed, built and instrumented by the author. This was necessary in order to control and measure process parameters. However the abrasive characteristics and process parameters were representative of industrial conditions. The coverage of the abrasives all follow similar trends which show a relatively linear increase with pressure at pressure levels within the test regime for the larger (3/4") nozzle. As the nozzle size gets smaller the slope of the lines at a distance of 20cm changes (gets smaller) and then levels off. Generally as the nozzle size increases the increase in coverage is slightly more than proportional with respect

to the nozzle orifice area. The coverage with silica sand was much lower than Black Beauty and abrasive bauxite, which latter two were quite similar. The relationship between mass flow rate and air pressure followed a similar trend as the abrasive coverage versus pressure, which was linear for the most part with the silica sand experiencing a peak at about 120 psi. Similar to the case of abrasive coverage Black Beauty and bauxite were close in value and generally twice the value of silica sand. There was a quadratic relationship between the impact force and air pressure with the maximum impact force occurring at 120psi. Impact force of the abrasives was independent of type of abrasive and particle size but increased quadratically with decrease in the nozzle to part distance. The fatigue limit of the blasted material depends on the surface roughness very strongly with average and maximum surface roughness showing no significant difference. There is a weak inverse dependence of fatigue limit with impact force.

Keywords: Abrasives, Millscale, Sandblasting, Surface Roughness.