Geophysical Research Abstracts
Vol. 19, EGU2017-232, 2017
EGU General Assembly 2017

Optimization of Auger System in Shallow Electromechanical Auger Drills

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In recent decades, electromechanical auger drilling has become a very popular method of ice core sampling, and the drilling sites are spread all over the world, covering the whole glacial distribution from polar to high-mountain regions. However, auger systems were usually determined by experience, and the main parameters (helix angle of the fights and rotational speed) are varied in a wide range from drill to drill. The external parameters which have a large influence on the efficiency of the cuttings transportation are friction coefficients between ice inner/outer barrels and the size distribution of ice cuttings. Totally 424 linear friction experiments with common and promising slider materials for auger drills were carried out at the wide range of temperatures observed in glaciers from -60 to 0 C. The coefficient of friction increases with decreasing of temperature but this dependence is not monotonous. To determine the patterns of ice cuttings, sixteen ice cuttings were sampled in the course of drilling in natural lake ice. The size distribution of the cuttings has an asymmetrical shape. Approximately half of the ice cuttings by weight are classified as small sized (<0.6 mm). In all of the sieving samples, the ice cuttings have prolate form with a ratio between the major and minor axis 1.55 in average. In order to choose the optimal auger parameters, the discrete element method is used to analyze the performance of cuttings transportation for different rotation speeds in the range 50–200 rpm and auger angles in the range 25–45°. Validation of optimal auger system were undertaken by field testes at high elevation glacier (5600m) in Xinjiang, China.