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TEMPERATURE CHANGE AND THE TOTAL STRESS ANOMALY IN PASTE BACKFILL

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ABSTRACT: This paper presents preliminary results from a laboratory backfill model test in order to explain the effect of temperature change during the cement hydration on the total stress within cemented paste backfill. It is conducted via temperature control test in the absence of the cement. This investigation is an attempt to resolve an anomalous behavior reported in recent full scale monitoring reports, where the total vertical stress at the stope base shows a progressive increase after backfilling is terminated. The result in this paper shows that the total vertical stress is not affected by the level of the temperature but rather by the temperature gradient. The empirical relationship between the temperature gradient and the change in the total vertical stress is proposed. The total stress anomaly found in the full scale monitoring of paste backfill could be explained by the finding.

Keywords: Backfill, Temperature, Arching, Total Stress, Anomaly

1. INTRODUCTION

Paste backfill is a type of material used to fill-up underground mined-out voids (stopes), which improves underground general stability condition. The material has a paste-like consistency made from a mixture of tailings, water, and cement binder to increase the strength of the paste. Figure 1 shows the paste backfill is being tested for its rheology property. The paste backfill or also called cemented paste backfill provides significant advantage in mining production as compared to the other type of backfills (e.g. hydraulic fill), which can be a self-supporting material. The adjacent ore bodies can be mined without the need of leaving some parts to act as underground pillars. Hence, the ore production can be maximized. The cemented paste backfill has been popularly used in the underground mining operations for the last two decades. Figure 2 shows a backfilling sequence in cemented paste backfilling.

During the backfilling, a barricade is constructed to plug the drawpoint. The barricade provides a temporary barrier to prevent the backfill to flow out of the stope until the backfill gains enough strength as a self-supporting material and be able to withstand pressure from blasting activity of the adjacent stope. As a temporary structure, the barricade has to be cost effective and acceptable in strength. When the barricade fails, a hefty amount of rehabilitation cost has to be spent and more importantly the safety of the underground workers is at serious risk.

In order to design an efficient barricade wall, the engineers must have a good understanding of the possible mechanisms within the paste backfill during and after backfilling, especially on the horizontal stress exerted by the paste backfill near the barricade. The conservative design practice uses the total vertical stress at the base (bottom) of the stope to estimate the maximum horizontal stress acting on the barricade wall. This assumption is reasonable since the total horizontal stress is equal to the total vertical stress during the backfilling (i.e., when paste is still in liquid phase) and the highest total vertical stress within the paste is located at the deepest location (i.e., at base).

Fig.1 Paste backfill

According to the overburdened stress theory [1], the total vertical stress (σ_v) is equal to: