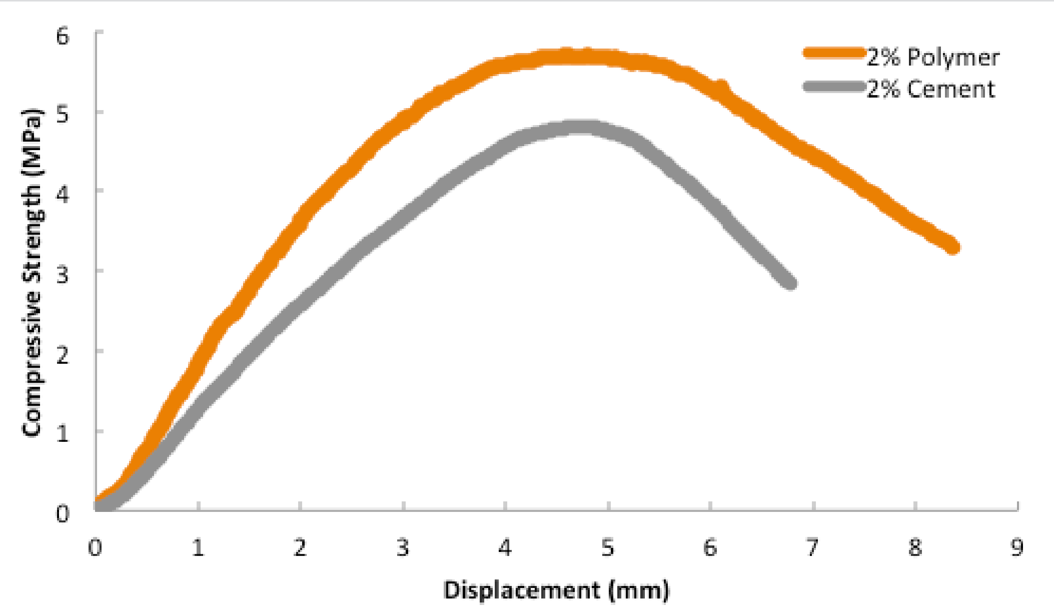
COMPARING NEW GRT POLYMER WITH CEMENT: DOES IT REALLY WORK?

Introduction: The research and development team at GRT has been working hard to tailor design new polymers and copolymers for soil modification and stabilisation. Polymers can increase flexibility and reduce shrinkage significantly, but sometimes cannot impart the same level of mechanical strength as traditional soil stabilisers such as cement. At GRT, we aim to change this.

Methodology: In the present work, latest GRT polymer is compared with cement. Standard static geotechnical tests were used to compare the performance of new GRT polymers with cement used to stabilise TMR Type 2.1 road base. Soil samples containing the same amount (2%) polymer and cement were prepared and Unconfined Compressive Strength (UCS) tests were performed according to Queensland Department of Transport and Main Roads (QDTMR) protocols.

Results: Are outline below in Figure 1, which compares stress - strain behaviours of soil samples treated with 2% cement vs 2% GRT polymer.

FIGURE 1



TYPICAL STRESS VS STRAIN CURVES OF UNCONFINED COMPRESSIVE STRENGTH (UCS) TESTS OF SOIL STABILISED

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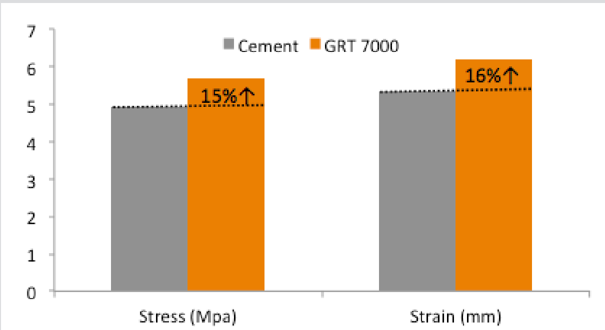
Discussion: The TMR Type 2.1 gravel stabilised using GRT polymer had higher maximum stress (UCS) and interestingly showed higher flexibility. As shown in Figure 2, strain and maximum stress was also greater when GRT polymer was used. 15% higher strength and 16% higher strain suggests that GRT polymer changes fracture mechanism of the soil.

FIGURE 2

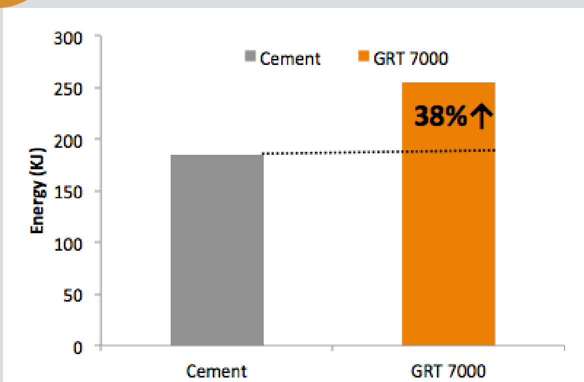


MAXIMUM STRESS (UCS) AND STRAIN AT MAXIMUM STRESS OF SOIL STABILISED USING 2% CEMENT VS. 2% GRT POLYMER

Fracture energy is usually calculated by measuring the area under force vs displacement curve. Because the failure point is not very clear when the mechanical strength of materials is measured in compression mode, the failure point was considered to be when strength is at 70% of its maximum. As shown in Figure 3, fracture energy, or in other words the additional energy required to break modified/treated soil is at least 38% when GRT polymer was used instead of cement.

The fracture surfaces of the UCS samples were closely examined using high resolution Scanning Electron Microscope (SEM). Images taken at 500, 1000 and 2000 times magnifications are presented in Figure 4. Surface topography of the soil stabilised using GRT polymer is smoother, while cracks and failure points are clearly visible in the soil stabilised using cement.

FIGURE 3



FRACTURE ENERGY OF SOIL STABILISED USING 2% CEMENT VS. 2% GRT POLYMER

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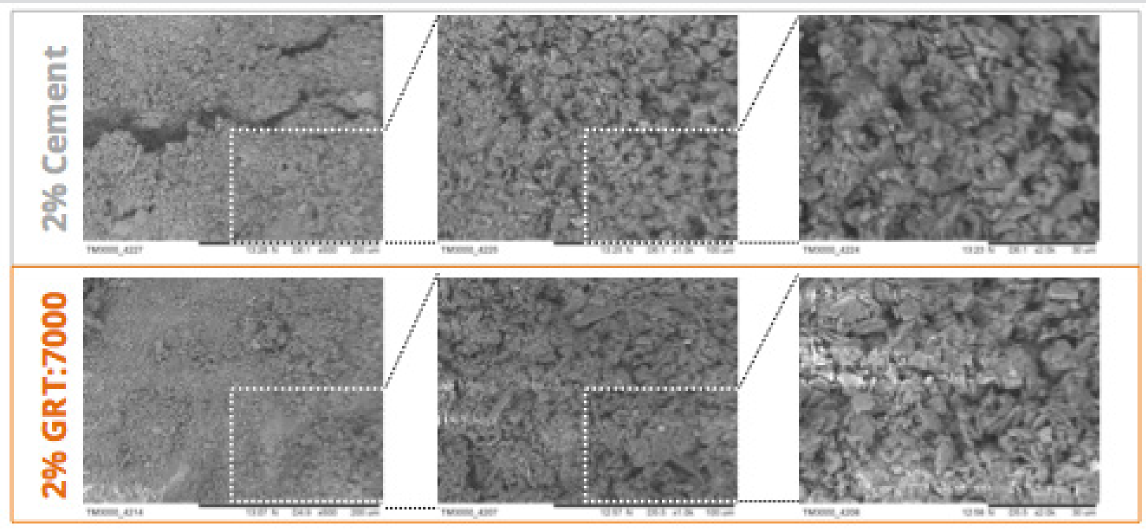
FIGURE 4



MICRO-STRUCTURE OF SOIL MODIFIED SOIL FRACTURE SURFACE IMAGED USING SCANNING ELECTRON MICROSCOPE (SEM).

At higher magnifications, soil particles are more visible and their interaction can be more clearly seen. The images at 2000 times magnification reveal aggregates of particles in the soil stabilised using cement. While, soil particles are more uniformly bonded in the soil sample stabilised using GRT polymer.

Conclusion: These results show that GRT polymer can impart higher mechanical strength to soil in comparison with same amount of cement. Higher levels of flexibility achieved using GRT polymer is also a clear advantage of this soil stabiliser over cement. Higher mechanical strength combined with more flexibility translates to significantly higher fracture energy that can be achieved due to the better performance of GRT polymer in bonding soil particles.