POWERCEM

TEMPORARY ROADWAY TRIALS

NEAR CHISLET, KENT

INTERIM REPORT

Report 1306/1

31st March, 2017

Land Research ASSOCIATES

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SUMMARY

This report provides interim results on the impacts on soils and agriculture after removal of a temporary roadway created using PowerCem. The 100 m trial roadway was created in February 2017 along the edge of an arable field near Chislet Business Park using an advanced cement-stabilisation method. The roadway was partly removed on 15th March 2017 by a Gutzwiller GM250 mixer/rotovator propelled by a 4-wheel drive Fendt tractor.

Trial pits dug along the rotovated strip indicate that where mixing had been set to a depth of 300 mm, the process has produced a layer with a fine tilth but there was still some residual cementation left below. Deeper rotovation appeared to remove all cementation but resulted in the agriculturally undesirable outcome of mixing clay subsoil with topsoil.

The most significant soil fertility-related differences between the trial strip and the adjacent field are the changes in pH and calcium carbonate content, both considerably elevated by the PowerCem treatment, and the halving of the soil nitrogen content. There was little effect on concentrations of available phosphorus, but levels of available potassium had been raised along the trial strip by the PowerCem process.

With fine tuning of treatment and removal depth the method appears to have potential for installing temporary roadways across agricultural land. At this stage the farming family certainly seem to favour a reinstated PowerCem strip to the geotextile and

1.0 Introduction

1.1 This report provides interim results on the impacts on soils and agriculture after removal of a PowerCem-created temporary roadway along the edge of an arable field near Chislet Business Park in East Kent.

TRIAL SITE ENVIRONMENT

1.2 The 100 m-long, 2.5 m-wide trial roadway (marked in yellow on the Google Earth image below) was installed in February 2017 along the edge of an arable field to the north-west of Chislet Business Park. The field was to be sown with a crop of beans for the 2017 growing season.

1.3 The land slopes gently down from a low ridge at the northern end of the trial strip. The soils are derived from a thin cover of drift deposits over London Clay. Investigation by soil auger alongside the trial strip showed 250-300 mm of heavy clay loam topsoil, either directly on slowly permeable clay subsoil or on a thin layer of heavy clay loam subsoil between the topsoil and clay. The topsoil is stonier along the upper half of the trial strip than along the lower half, coinciding with the mottled tone on the Google Earth image below.

1.4 A second trial roadway planned for a field to the east (circled) had not been created due to ground conditions being too wet.

2.0 Roadway removal

2.1 The trial roadway was removed on 15th March 2017 using a Fendt 939 4-wheel drive tractor with a Gutzwiller GM250 mixing/rotovation drum to break up cementation. The process is pictured below.

2.2 The removal operation was witnessed by the author of this report, representatives of PowerCem, Barton Plant and Carillion, as well as a soil science consultant working for National Grid, a geotechnical consultant working for PowerCem and Laura Headley from the farm hosting the trial.

2.3 The mixing produced a soil surface slightly raised above the adjacent field, particularly so along the first 20 m of roadway removal (see image below) where the tool depth had been set too deep (500 mm) and subsoil clay had become mixed with the agricultural topsoil. However, grading and lightly consolidating the strip using a tracked Caterpillar D6 bulldozer resulted in a soil surface at the same level as the adjacent land.

3.0 Soil condition and fertility immediately post-removal

3.1 The removal process had created finely-tilthed topsoil where rotovation had been set to 300 mm depth. However, a mixed layer of topsoil and subsoil had been created along the upper part of the trial strip where rotovation had been to 500 mm. The eastern edge of the trial roadway had not been completely removed due to equipment breakdown[1].

SOIL INVESTIGATION AND SAMPLING

3.2 Four small pits were dug at 20 m intervals along the western two thirds of the trial strip where rotovation was complete, with four parallel pits 10 m to the east in unamended soil.

3.3 The southern three pits, where rotovation had been set to 300 mm-deep, showed a good breakdown of the cementation into fine aggregates. However, unlike the adjacent unamended soil which could be augered to at least 500 mm depth, it was impossible to work a hand-auger below the rotovated layer in the trial strip. This indicated that some cementation extended below the planned 300 mm depth. This could impede the downward extension of crop roots during the growing season and possibly impede downward drainage of excess rainfall. The trial pit in the section of the strip that had been rotovated to 500 mm depth indicated that all cementation had been removed, but with an agriculturally-undesirable outcome of mixing at least 200 mm of subsoil clay into the topsoil layer.

3.4 As complete removal of the trial roadway had not been completed due to equipment breakdown, no comparative measurements of bulk density or penetration resistance were made on 15th March. However, samples of the rotovated layer in the trial strip and adjacent cultivated agricultural topsoil were taken from each of the small pits (eight samples in total) and sent for fertility analyses at the laboratories of NRM Ltd.

3.5 The results are shown in Table 1 on the following page. The presence of liming agents in the Powercem additions is clearly reflected in the mean pH levels - 10.9 along the roadway strip and 7.7 in the adjacent land. The pHs reflect the difference in calcium carbonate levels –on the roadway strip three to seven times the average level on the adjacent land.

[1] The work was completed the following day using a Wirtgen w250i combination machine

3.6 On the unamended land adjacent to the trial strip added lime was recorded in the topsoil of the southern part of the field but not further up the slope. This accounts for the greater variability in calcium carbonate content in the B series of samples.

Table 1. Fertility analyses along the trial strip (samples A) and adjacent land (samples B)

Sample*	pH	$CaCO_3$	Organic matter %	Total N (%)	Available P mg/l (index)	Available K mg/l (index)	Available Mg mg/l (index)
A1	11.1	8.5	3.3	0.09	77.8 (5)	368 (3)	43.3 (1)
B1	7.9	4.2	4.0	0.18	70.6 (5)	325 (30	33.8 (1)
A2	10.9	6.0	3.7	0.08	46.6 (4)	225 (2+)	51.5 (2)
B2	8.1	1.9	3.8	0.15	41.4 (3)	151 (2-)	69.1 (2)
A3	10.8	6.3	3.5	0.07	44.8 (3)	235 (2+)	48.7 (1)
B3	7.6	<1	3.9	0.14	47.2 (4)	190 (2+)	65.2 (2)
A4	10.9	7.7	3.3	0.07	43.4 (3)	249 (3)	44.7 (1)
B4	7.2	<1	3.8	0.15	45.4 (3)	164 (2-)	44.3 (1)
Averages							
All A	10.9	7.1	3.5	0.08	53,1 (4)	269 (3)	47.0 (1)
All B	7.7	1,9	3.9	0.15	51.2 (4)	207 (2)	53.1 (2)

* Samples numbered from south to north

3.7 Concentrations of organic matter, nitrogen and available magnesium are consistently lower on the rotovated strip, suggesting that some subsoil had been incorporated even where the rotovation depth had been restricted to 300 mm. There was little effect on concentrations of available phosphorus, but levels of available potassium had been raised along the trial strip by the Powercem process.

4.0 Interim conclusions

4.1. The most significant fertility-related differences between the trial strip and the adjacent field are the changes in pH and calcium carbonate content (both of which had been considerably elevated by the PowerCem treatment) and the apparent halving of nitrogen levels in the soil. The intention is to try to blend in adjacent unamended topsoil when rotovating the redundant Roadcem construction and this would help mitigate these effects.

4.2. The reduction along the trial strip of organic matter and available magnesium levels are much smaller and consistent with a small amount of mixing of low fertility subsoil and higher fertility topsoil during rotovation.

4.3. Where the PowerCem strip had been rotovated to 500 mm it appeared that all of the treated depth had been broken up. However, by doing so, 200 mm of subsoil clay had been mixed with the topsoil. This needs to be avoided, particularly on soils with clay immediately below the topsoil. If the topsoil and the immediate underlying topsoil are both of loamy or sandy soil texture mixing will have less critical effect on the physical performance of the topsoil, although it will inevitably reduce the levels of major plant nutrients in the agricultural cultivation layer. Coring the roadway before removal would provide the information to ensure that the full depth of cementation is removed.

4.4. Immediately after removal of the trial a bean crop was sown across the whole field. The very high pH is likely to reduce germination of bean seeds and perhaps make those plants that become established more vulnerable to plant diseases. Reduction in pH levels and crop establishment and health will be checked later in the growing season.

4.5. With fine tuning of treatment and removal depth, including overlapping the rotovation to blend in unamended topsoil, the method appears to have potential for installing temporary roadways across agricultural land. It would have far less environmental impact than stripping topsoil to one site, importing large volumes of stone, tracking it across farmland and reversing the process after site works have finished. At this stage the family farming the trial site land certainly seem to favour a reinstated Powercem strip to the geotextile and roadstone alternative.