Ground Improvement

PolyCom

Adding workability
Increasing ground strength
Delivering water resistance

Strength & water resistance

Clays,silts,loams,gravels and crushed rock

"It's all about improving and preserving the dry strength of the available material"

Reactive clays

Highly reactive clay

With correct treatment
Now a useable sub-grade

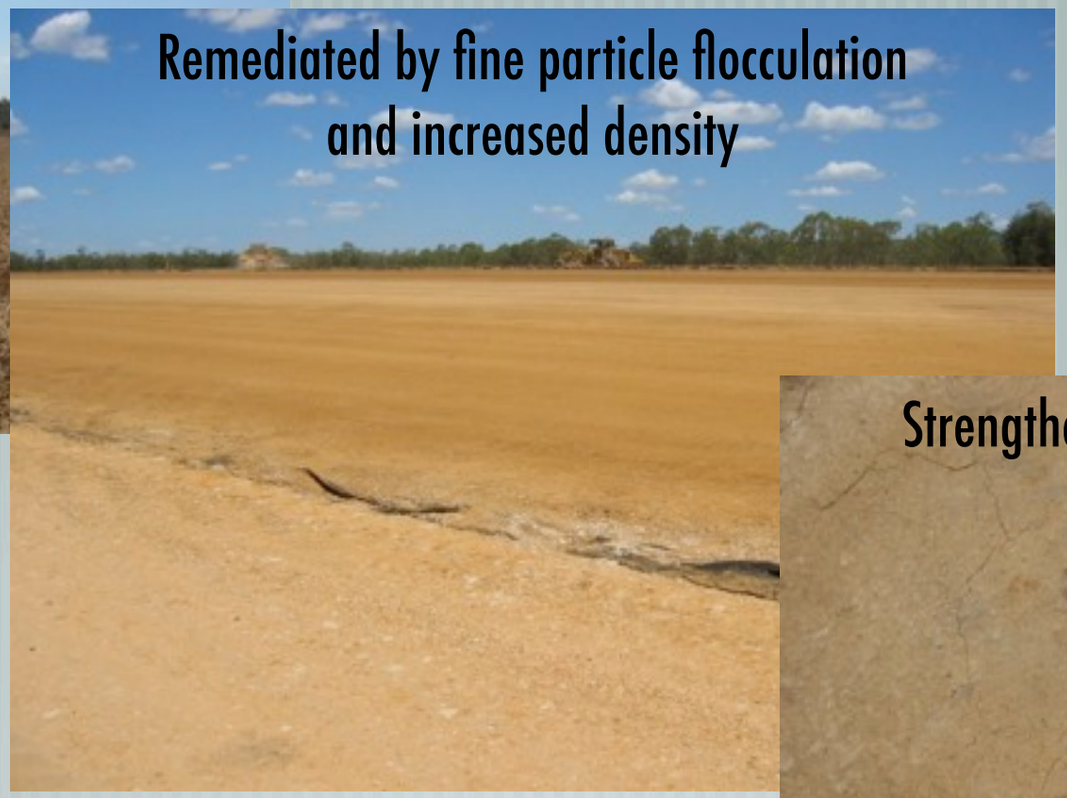
PolyCom delivers increased strength to clay but more importantly - prevents softening of the treated area

Alexanderson Civil

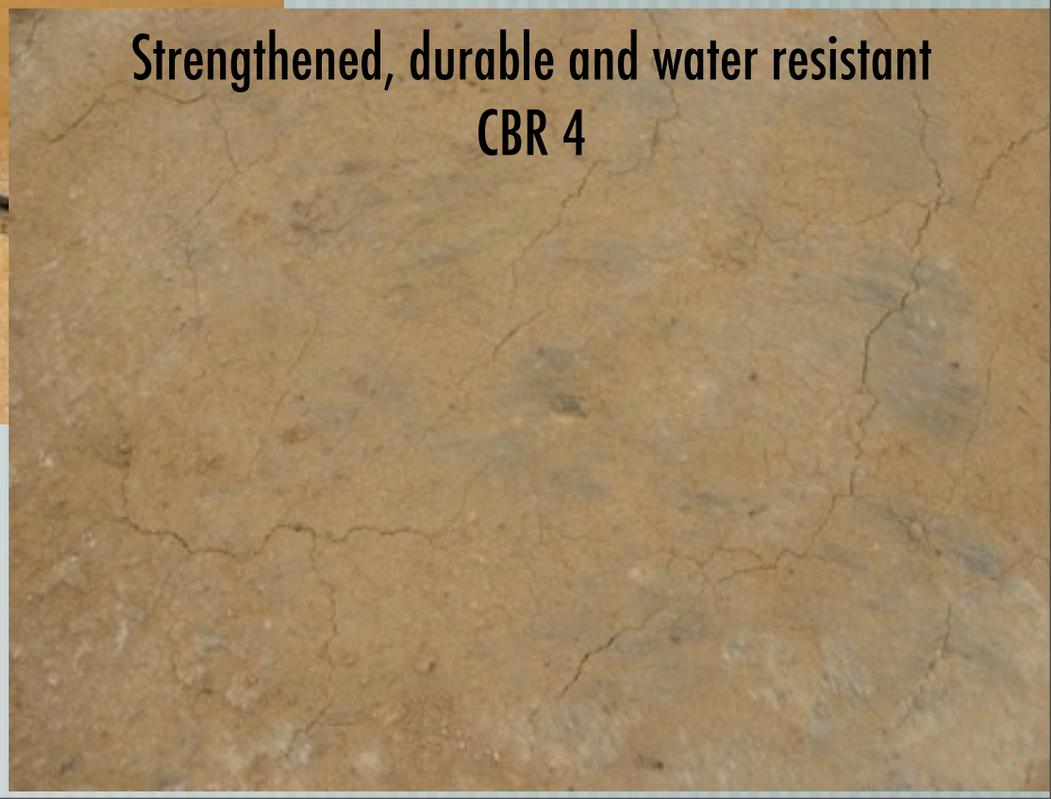
Dispersive soils

High sodic level dispersive soil
CBR 2

Remediated by fine particle flocculation
and increased density



Strengthened, durable and water resistant
CBR 4



Origin Energy Gas Plant Construction

Watpac Construction

Sandy loam

Sandy loam
difficult to manage - normally cut to spoil

Rip and re-compact - standard wet mix with PolyCom

Strengthened sub-grade means thiner pavement

Alpha Coal Project
Access Road

Shadforths Civil

Black soil

Mow grass and scarify

5 days later - haulage completed

QGC Rig access

Ostwald Construction

Wet mix profile and compact

2 weeks later and constant traffic

Tertiary clay

Mine road wear course improvement utilising in-situ mine spoil

Hard wearing - water resistant - easily managed

PolyCom stabilisation negates the need for gravel sheeting
All weather surface reduces maintenance and watering requirements by 80%

Haul Road 'A'
Jellinbah Mine

Mud stone

Mud stone haul road

All weather road
80% less water

Southern Haul Road
Minerva Mine

Mud stone + PolyCom

7 months on
and no maintenance

Permian clay

Capping of Permian clay in cut to fill operation
Reduces traffic and water damage during construction phase

Hunter Expressway - Thiess Construction

Bush gravel

In-situ pavement - reddish brown gravelly clay - pre work CBR 14
PolyCom eliminated the requirement for a rebuild - post work CBR 66

Main Roads, Qld

Natural ground

Pre-work

Natural ground softens during rain event Feb 2010

35 klm of PolyCom road up-grade - Duaringa-Bohemia Downs Road

Post work

Stabilised and no ill effects after two metres of rain 2010 - 2011

Crushed rock

Full stabilisation with a grader crew

3 Hectare - heavy machinery lay down area

BMA - Crinum Mine
Garwoods Earth Moving

Durable, economical and water resistant

In-situ gravel

PolyCom stabilised pavement

Moonie, Qld
RoadTek

Simple insurance

Grain storage access - Emerald, Qld

Installation methods

Stabilising machine

Standard construction method

Cunningham Hwy, Warwick, Qld
CMC Construction

Increased strength, flexible pavement, water resistance

Installation methods

Standard grader wet mix

Haul road ‘A’
Jellinbah Mine

Loaded scraper for compaction

Installation methods

Pad foot rollers

Utilised here for mixing and compaction

Black soil sub-grade improvement
Toowoomba Regional Council
Mt. Tyson Road

Black soil sub-grade normally cut to spoil -
strengthened, water resistant and waiting for the gravel

Installation methods

1. ARTC access road
2. Highway patches
   Calder Hwy, Vic roads
3. Truck parking bays
   Bruce Hwy,Yaamba,
   Qld, QBC
4. Wear course upgrade
   Bendigo Council

Cost Benefits - Mining

Details Of Works

Wear course improvement work was completed by Minerva on-site crew.

Minerva mine is situated south of Emerald, Qld
Haul roads are constructed of mine spoil (mainly mudstone with some blast rock)
Road structure was stable and settled but wear course was prone to dust, blowouts and soft spots. These roads also softened to a depth during rain events.
Solution was to re-sheet with locally available basalt and stabilise with PolyCom to an approximate depth of 100mm.

Plant:
Grader, water cart and a loaded truck for rolling.

Method:
6,000m x 30m x .1m
PolyCom required - 18,000m3 @ 1Kg/25m3 = 720Kg PolyCom

PolyCom was mixed and applied as per method statement for grader only stabilisation work.

Result:
Minerva mine now has durable all weather haul roads which are now an asset instead of a liability. This improved road surface delivers savings in fuel, tyres, water, maintenance and damage to truck chassis and suspension components.

Case study - Minerva Mine haul roads	PolyCom Stabilised Haul Road - Costs/klm	Untreated Haul Road - Costs/klm
Initial Cost - 1000m x 30m x .1m	★PolyCom $30,000 + Equipment and crew - Total **$43,800**	Existing haul road
Yearly maintenance grading	Average one per two months @ $300/hr - yearly **$1,800**	Average grading - one per week @ $300/hr - yearly **$15,000**
Yearly repairs to blowouts	**$1,500** (mainly shoulders**)**	Average one hour per week @ $300 hr - yearly **$15,000**
Yearly watering for dust	Average once per day shift + once per night shift @ $90 ea - yearly **$54,000**	Average watering every 93 min - 8 per day shift + 4 per night shift @ $90 ea - yearly - **$324,000**
PolyCom maintenance cost per Klm per year	Three applications per week during normal daily water **$36,000**	zero
Cost per Klm per year for maintenance and dust control	Total **$137,100**	Total **$354,000**

★ PolyCom cost $30,000 + Equipment - Grader (16G), water cart (10,000 litre), Loaded truck (compaction). Two days work @ $13,800

Total yearly savings: Maintenance and watering only per klm - **$216,900** (these are particularly conservative figures)
Second year saving of **$260,700** is realised with the removal of the initial application value.

Not taken into account are savings in CO2 emissions, water, haul fleet fuel, tyres, chassis damage, engine damage from dust ingestion.

Validation example - Jellinbah Mine

Validation of improved road performance

- **Dynamic modulus of haul road running surface**

  Dynamic Modulus measured using Light Weight Deflectometer Test (LWDT) indicates a considerable improvement following HIEDYC™ Compaction and PolyCom Stabilisation. The comparison of mean dynamic modulus before and after ground treatment (compaction and stabilisation) is provided below.

Road dynamic modulus results before and after Ground Treatment

Status of running surface

Mean dynamic modulus (MPa)

In as presented status (prior to ground treatment)

38.8

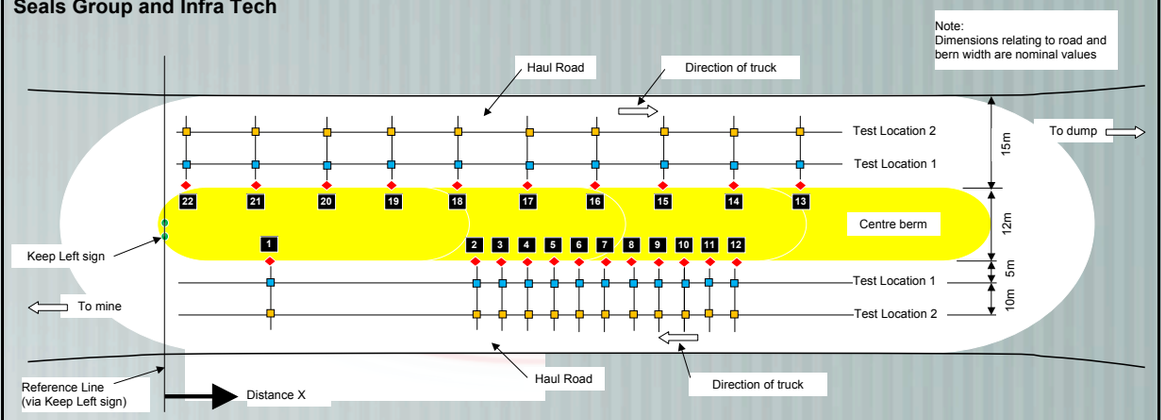
Following the ground treatment

69.0

The results relating to the road that underwent the complete ground treatment (HIEDYC™ Compaction and PolyCom Stabilisation) shows an increase in the dynamic modulus of **78%**.

LWDT Results

Running Surface Compaction and Stabilisation Project, Jellinbah Mining Limited
Seals Group and Infra Tech



Test point Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Distance X	47.4	463.8	506.4	550.0	594.0	638.0	681.6	723.0	764.6	805.7	848.0	890.0	903.0	803.0	703.0	603.0	503.0	403.0	303.0	203.0	103.0	3.0
LWDT Results - Test Location 1 (Prior to Treatment)	41.8	49.4	33.9	38.8	41.9	30.9	30.1	32.0	41.3	51.7	28.4	47.6	31.3	42.4	30.7	42.9	37.8	19.7	44.3	47.1	45.9	45.4
LWDT Results - Test Location 1 (After Treatment)	80.9	104.5	104.2	86.4	74.2	59.9	66.6	86.1	49.9	78.9	40.2	68.0	73.0	75.6	58.8	91.2	70.2	73.1	59.9	63.3	59.2	77.7
LWDT Results - Test Location 2 (Prior to Treatment)	45.4	38.1	37.8	41.0	39.0	31.9	29.1	36.4	34.6	39.9	30.4	70.6	32.5	32.1	31.3	51.9	37.9	29.8	45.0	39.3	37.9	38.1
LWDT Results - Test Location 2 (After Treatment)	62.5	72.2	73.5	72.3	67.5	61.3	50.0	95.3	29.3	54.9	47.3	78.5	74.0	73.2	69.9	84.4	74.4	60.3	60.8	60.1	50.2	62.2

Validation example - Jellinbah Mine

Validation of rolling resistance improvement

- **Haul road rolling resistance**

  Rolling resistance is one of the major components of the total resistance against truck movement.

  Main components of the resistance to truck movement are;
  1. Resistance due to grade (grade resistance) – (R_G)
  2. Rolling resistance (acting on truck tyres from the running surface) – (R_R)
  3. Resistance of transmission components when on neutral – (R_T)
  4. Wind resistance – (R_W)

  Above 1 and 4 are negligible with level surface and low wind speeds, while above 3 is considered to be similar for both pre and post ground improvement situations. Considering R_R to be the significant component, the calculated resistance against truck movement was considered as rolling resistance.

  The results of calculated parameters are shown below.

  Pre Compaction and Stabilisation
  R - Total Resistance (kN) **79.1850**
  Coefficient of Friction of Running Surface (μ) 0.260

  Post Compaction and Stabilisation
  R - Total Resistance (kN) **67.4958**
  Coefficient of Friction of Running Surface (μ) - 0.221

This is a **15%** reduction in resistance against truck movement (approximated to rolling resistance).

Rolling resistance test

Fully loaded 789

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