



EFFECT OF GROUND TIRE RUBBER ON OPEN-GRADED MIXTURE PERFORMANCE

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PRINCIPLE



Open Graded Friction Course Mixture

- Porous – 15% Voids
- Increases in wet weather friction
- Susceptible to ravelling and rutting
- Generally using polymer and fibre additives

Ground Tyre Rubber

- Two forms
- Waste reuse
- Environmental benefits
- Economically efficient
- Requires performance evaluation

PURPOSE OF THE PAPER

Compares the performance of 7 Open Graded mixture types

- 6 rubber modified products and 1 control specimen
- Same aggregate skeleton for all mixtures

Tests:

Draindown

Durability

- Cohesion
- Rutting
- Permeability



DRAINDOWN TESTING

To ensure that the draindown is within acceptable levels, encountered during production, storage, transport and placement of mixture

1. Tested at 2 different temperatures
 - the anticipated plant production temperature (here: 151°C)
 - 15°C above that temperature
2. Place sample into tared wire basket (do not consolidate sample).
3. Place basket into the oven for 60 + 5 minutes
4. Remove basket and determine the mass of drain down material



DRAINDOWN TESTING - RESULTS

Table 7. Draindown of Laboratory Produced OGFC Materials

| Temp (°F) | Specimen | Control | Liberty -20 @15% | Liberty Cryohammer -30 | Liberty Crackermill | Lehigh MD-400-TR | MD-400-AM | MD-105-TR |
|-----------|----------|---------|------------------|------------------------|---------------------|------------------|-----------|-----------|
| 305 | 1 | 0.06 | 0.17 | 0.16 | 0.11 | 0.28 | 0.23 | 0.06 |
| 305 | 2 | 0.45 | 0.20 | 0.18 | 0.07 | 0.30 | 0.28 | 0.09 |
| 332 | 1 | 0.03 | 0.05 | 0.29 | 0.12 | 0.13 | 0.11 | 0.13 |
| 332 | 2 | 0.05 | 0.09 | 0.09 | 0.07 | 0.63 | 0.16 | 0.06 |

PERFORMANCE TESTING

Tests

Hamburg testing

Asphalt Pavement Analyzer

Cantabro testing

Permeability testing – Florida Method



HAMBURG TESTING

Test for rutting performance

Max acceptable rutting criteria 0,5 inches

Testing apparatus –

- water bath and weighted testing wheel

- Uses set sample size

20 000 passes of the tracking wheel



HAMBURG TESTING - RESULTS

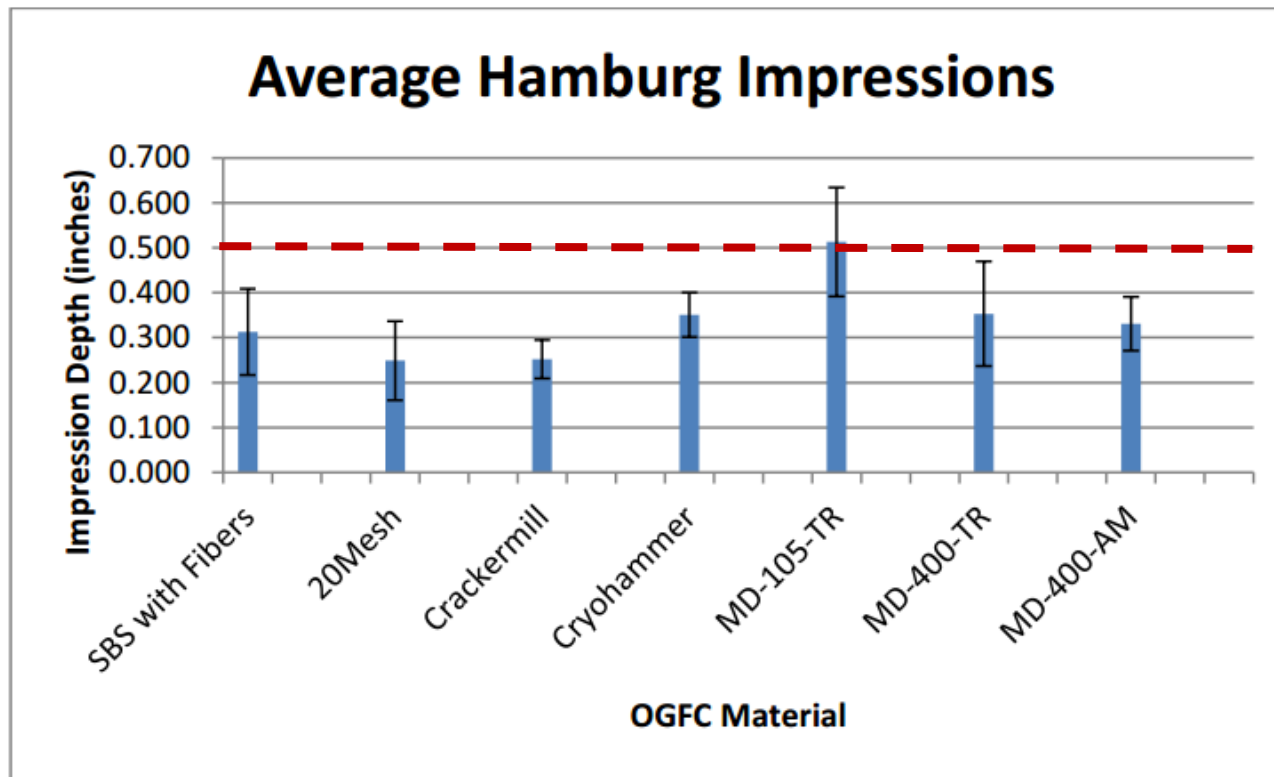


Figure 3. Average Hamburg Impression Depths

ASPHALT PAVEMENT ANALYZER

Test for rutting susceptibility of the material

Testing temperature 64°C for at least 4 hours

Beam or cylindrical samples under repetitive wheel loads, measuring the amount of permanent deformation under the wheel path



ASPHALT PAVEMENT ANALYZER - RESULTS

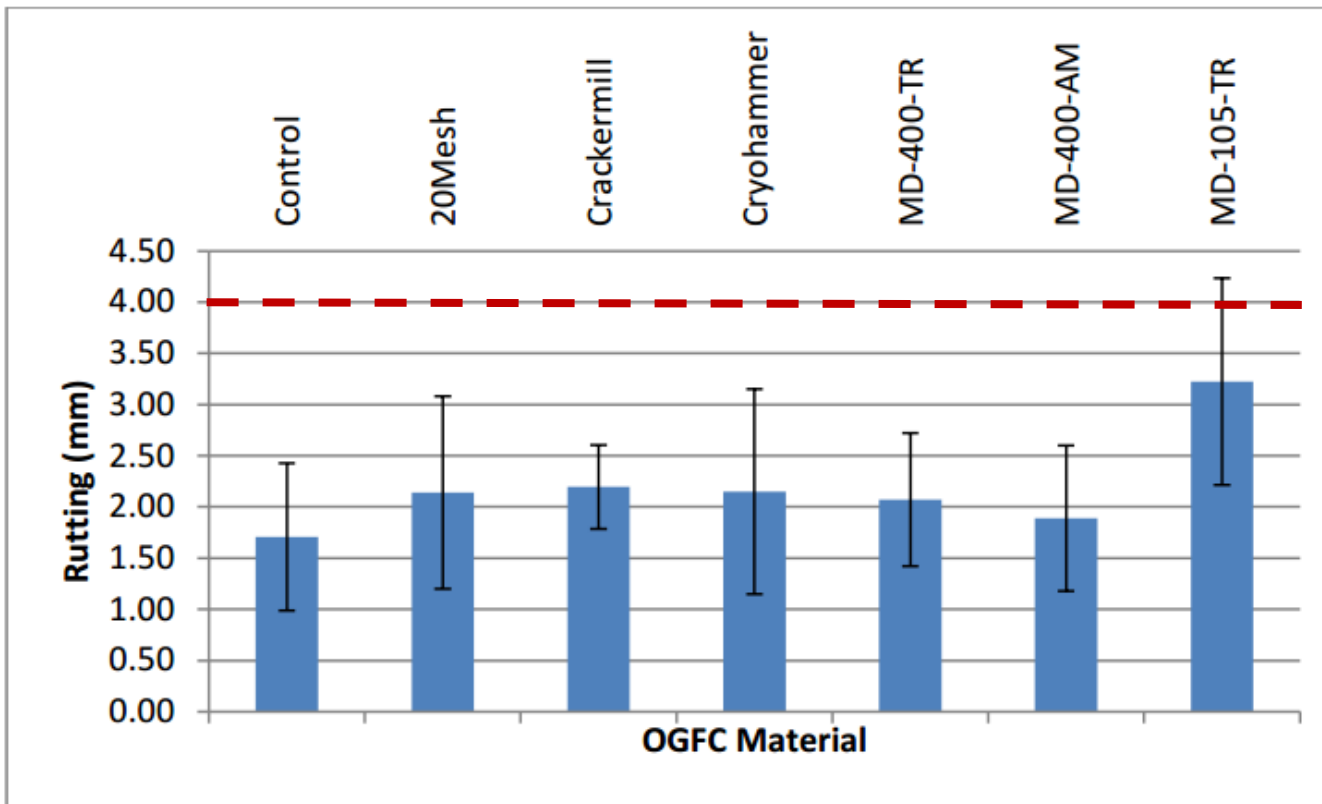


Figure 1. Average Rut Depth from APA Testing

CANTABRO TESTING

To evaluate the cohesion, bonding, and effects of abrasion on the open graded materials

The materials are tested at room temperature in a L.A. Abrasion machine.

Specimens are subjected to abrasion for 300 revolutions at a rate of 30 to 33 revolutions per minute. The material loss from each specimen is measured.



CANTABRO TESTING - RESULTS

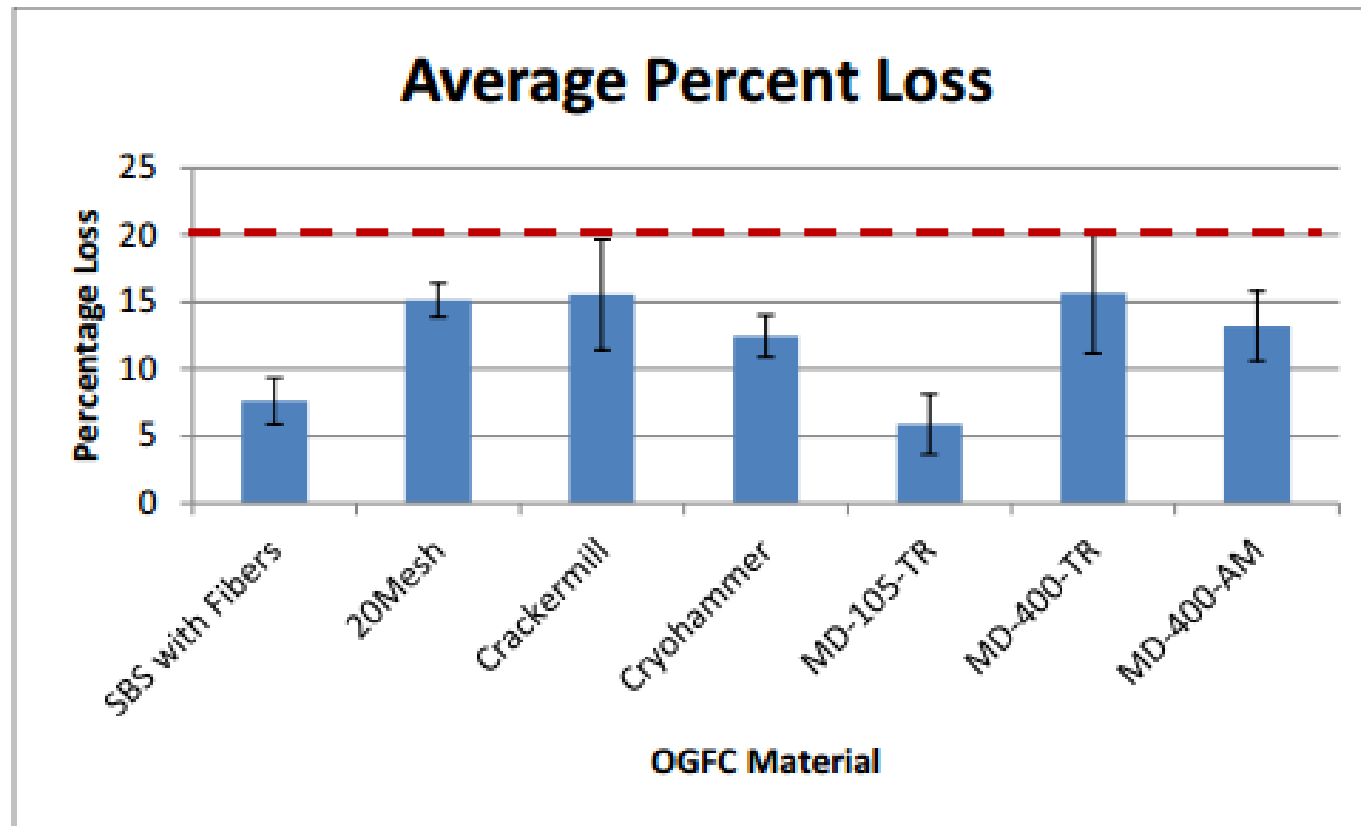


Figure 2. Average Percentage of Material Loss from Cantabro Testing

PERMEABILITY TESTING — FLORIDA METHOD

To test the permeability of the modified asphalt mixture

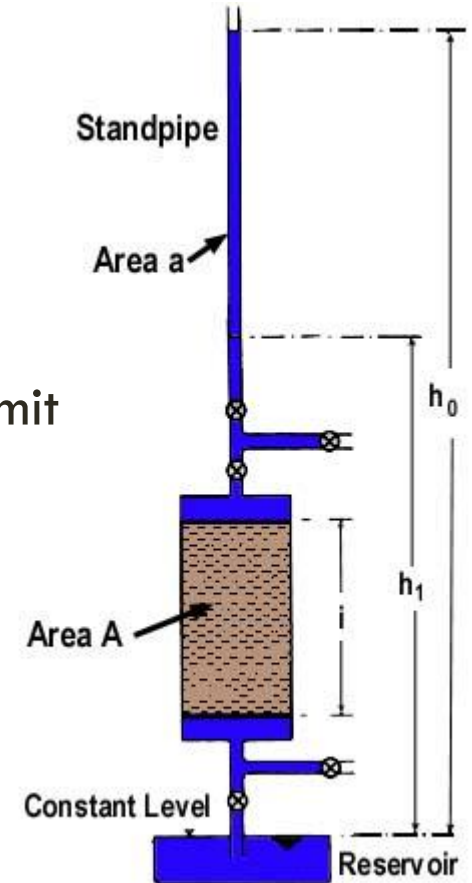
Falling head equation used to determine the values of permeability

$$k = \frac{a * L}{A * t} * \ln \frac{h_1}{h_2} * t_c$$

THE FALLING HEAD PERMEABILITY TEST

To determine the coefficients of permeability

1. Saturated specimen
2. Standpipes are filled with de-aired water to a given level
3. Water flow through the specimen until the water reaches a given limit
4. The time required for the water in the standpipe to drop from the upper to the lower level is recorded



PERMEABILITY TESTING – FLORIDA METHOD - RESULTS

Table 8. Average Permeability of Laboratory Compacted OGFC Materials

| Material | Average Permeability (10^{-5} cm/s) | Standard Deviation of Permeability (10^{-5} cm/s) |
|-------------|--|--|
| Control | 21,346 | 8,438 |
| 20Mesh | 9,000 | 1,441 |
| Crackermill | 12,795 | 6,826 |
| Cryohammer | 15,876 | 817 |
| MD-105-TR | 15,985 | 5,913 |
| MD-400-TR | 18,676 | 5,846 |
| MD-400-AM | 17,008 | 5,904 |

SUMMARY

Results

- No dramatic difference in durability over any mix or test
- Observed failures
- Binder optimisation required for permeability

Conclusion

With appropriate mix testing, the GTR is an appropriate replacement.

It should however be monitored in the field to truly assess it's performance



REVIEW

General Findings

- Overall findings of the report were well delivered
- Excellent structure and clear language used in the report
- Some minor issues with table referencing and introducing technical terms
- Some reliance on other papers



REVIEW

Methodology

- Binder properties inferred
- Constant Aggregate Skeleton
- All tests follow AASHTO or Department of Transport procedure but not greatly explained
 - APA: number of load cycles, target value
 - Permeability: target value
- Statistical analysis where applicable



REVIEW

Conclusions and Recommendation

- Dot point formatting
- Comparison to other studies
- Future application options but no further research options



ASSESSMENT

Improvements

- Glossary of terms
- Aesthetics
 - Paragraphed Recommendations
 - Centred Tables and Figures
- More background on borrowed research
- Stating permeability requirements



QUESTIONS?

