



# An adaptive asphalt to mitigate raveling

Laura Traseira Piñeiro\*, Alvaro Garcia, Tony Parry

\*laura.traseira@nottingham.ac.uk

Faculty of Engineering, The University of Nottingham, University Blvd, Nottingham NG7 2RD

## INTRODUCTION

Asphalt raveling consists of a loss of coarse aggregates from the surface of the asphalt [1]. This phenomenon has its origin in a lack of adhesion between aggregates and the binder, or as a result of a brittle fracture of the binder that leads to a poor bond between aggregates [2].



Figure 1. Raveling on an asphalt surface [3]

Since the major cause of failure is due to shear forces induced by traffic [4], the use of an adaptive asphalt that contains encapsulated rejuvenators that act under external stimuli could retard the apparition of pavement raveling.

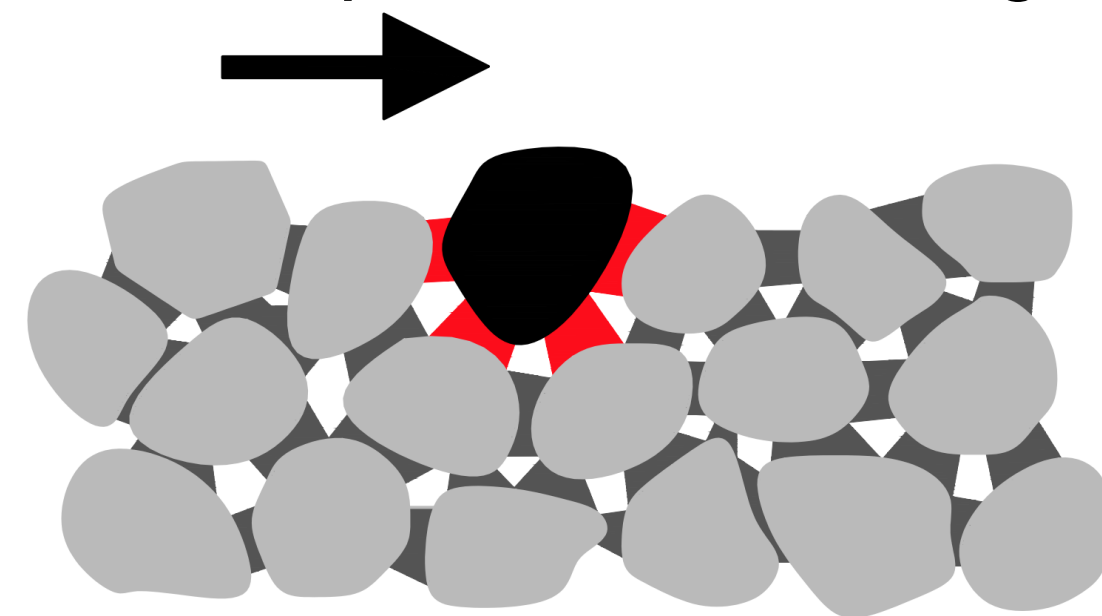


Figure 2. Shear stress in the asphalt surface provoked by the scuffing action of the tyres

## OBJECTIVES

1. Assessment of the action of encapsulated rejuvenators on the mitigation of asphalt raveling.
2. Quantification of the effect of the capsules and development of degradation curves based on the particle loss.
3. Optimization of the encapsulated rejuvenators, in order to maximize their efficiency in the extension of the lifespan of the asphalt.

## METHODOLOGY

1 Manufacturing of encapsulated rejuvenators

2 Determination of particle loss by Cantabro test

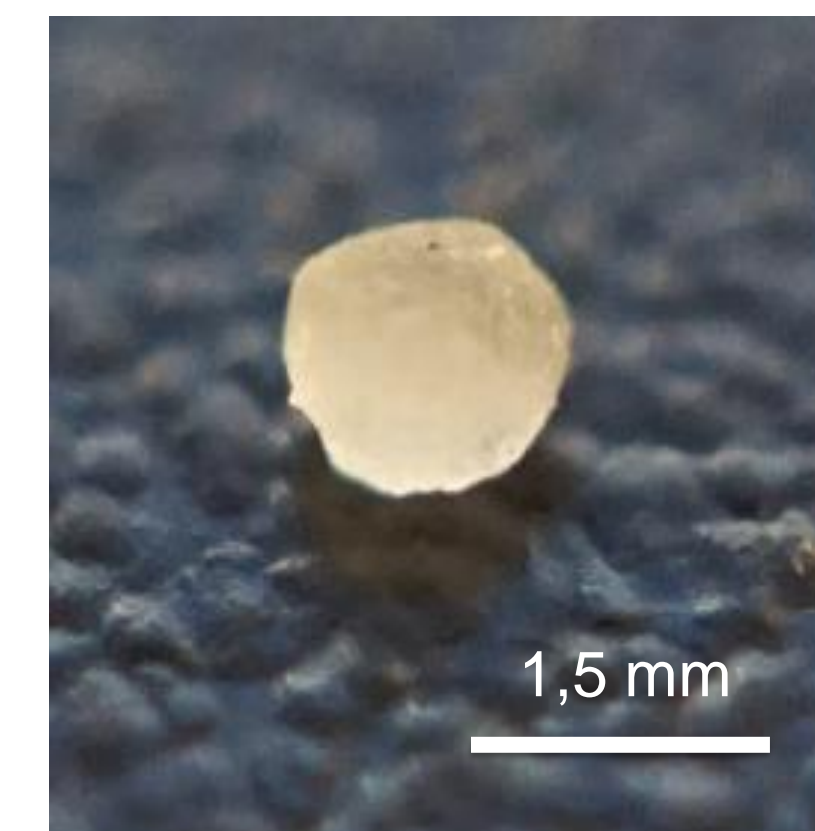


Figure 3. Rejuvenator agent (sunflower oil), encapsulated by ionotropic gelation of sodium alginate in a calcium chloride solution [5]

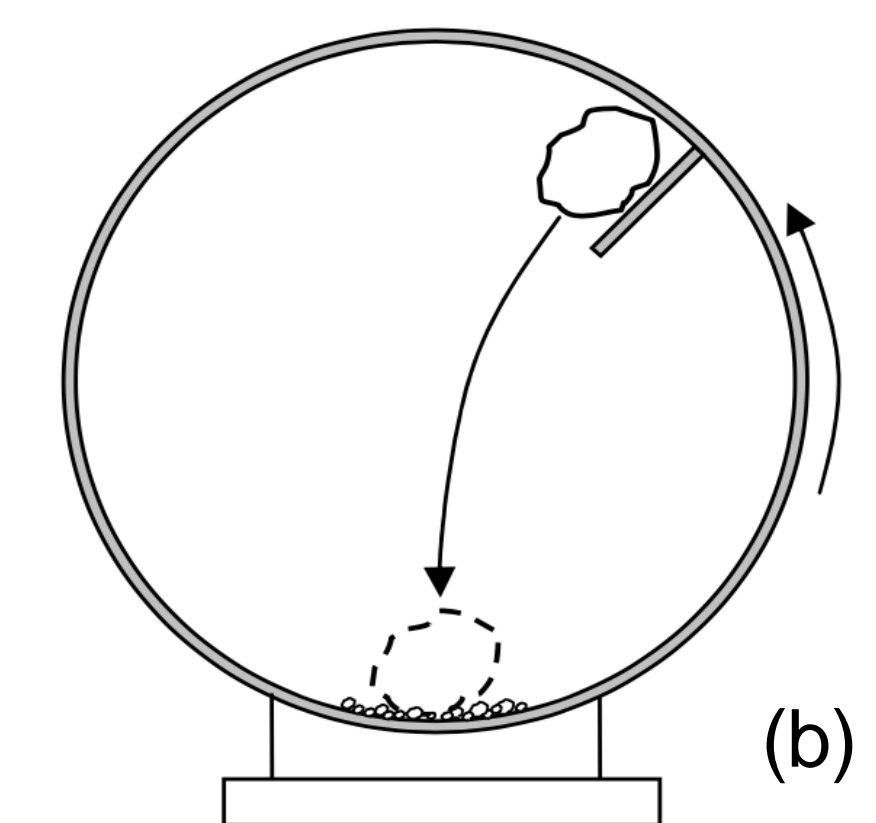


Figure 4. Cantabro test: (a) Los Angeles drum; (b) illustration of operation inside the drum [6]

3 Rutting testing with Hamburg Wheel Tracker

4 Study of the influence area of the capsules (compression testing + digital image correlation software)

## CURRENT WORK

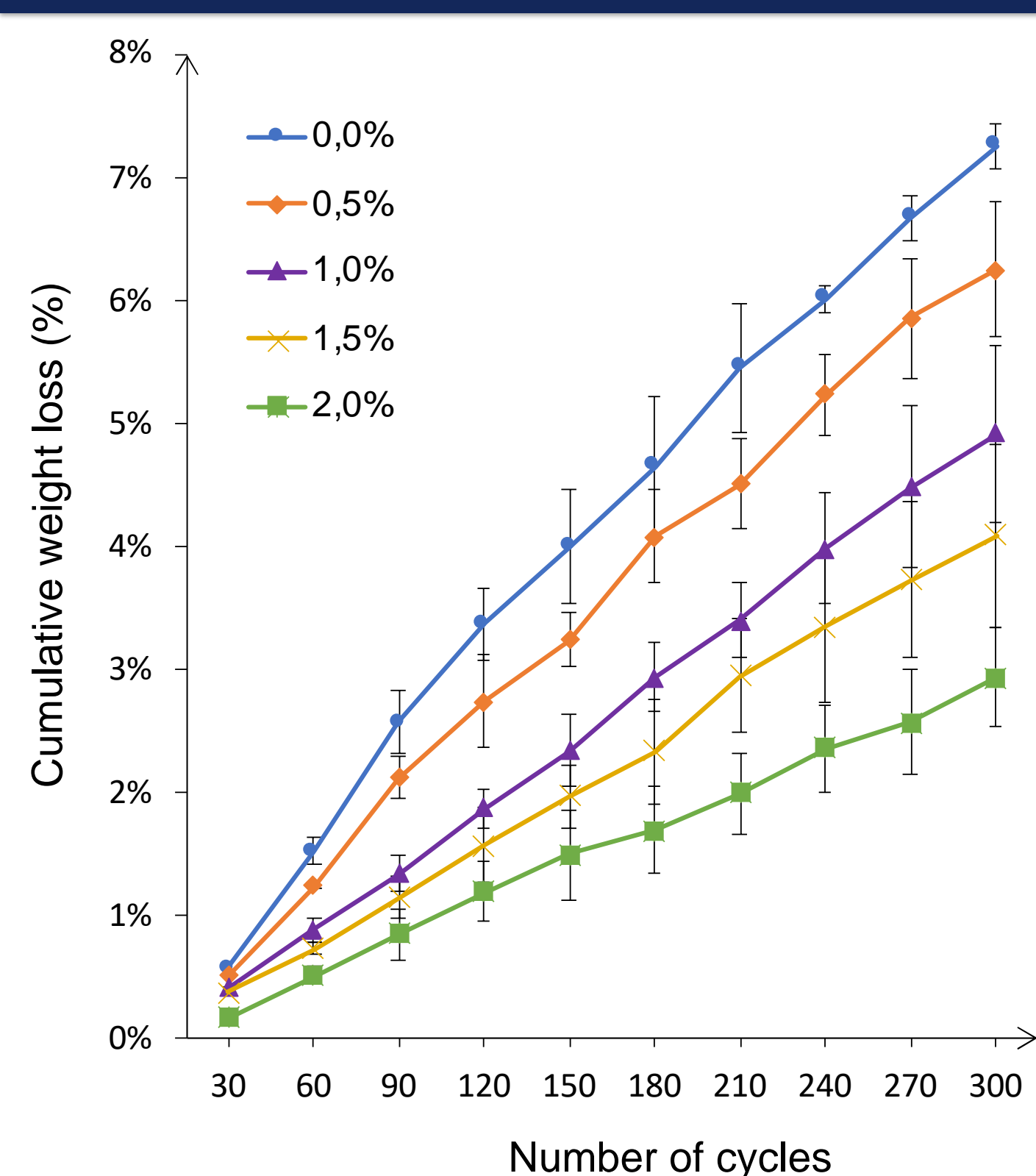


Figure 5. Weight loss over cycles in asphalt with different contents of capsules

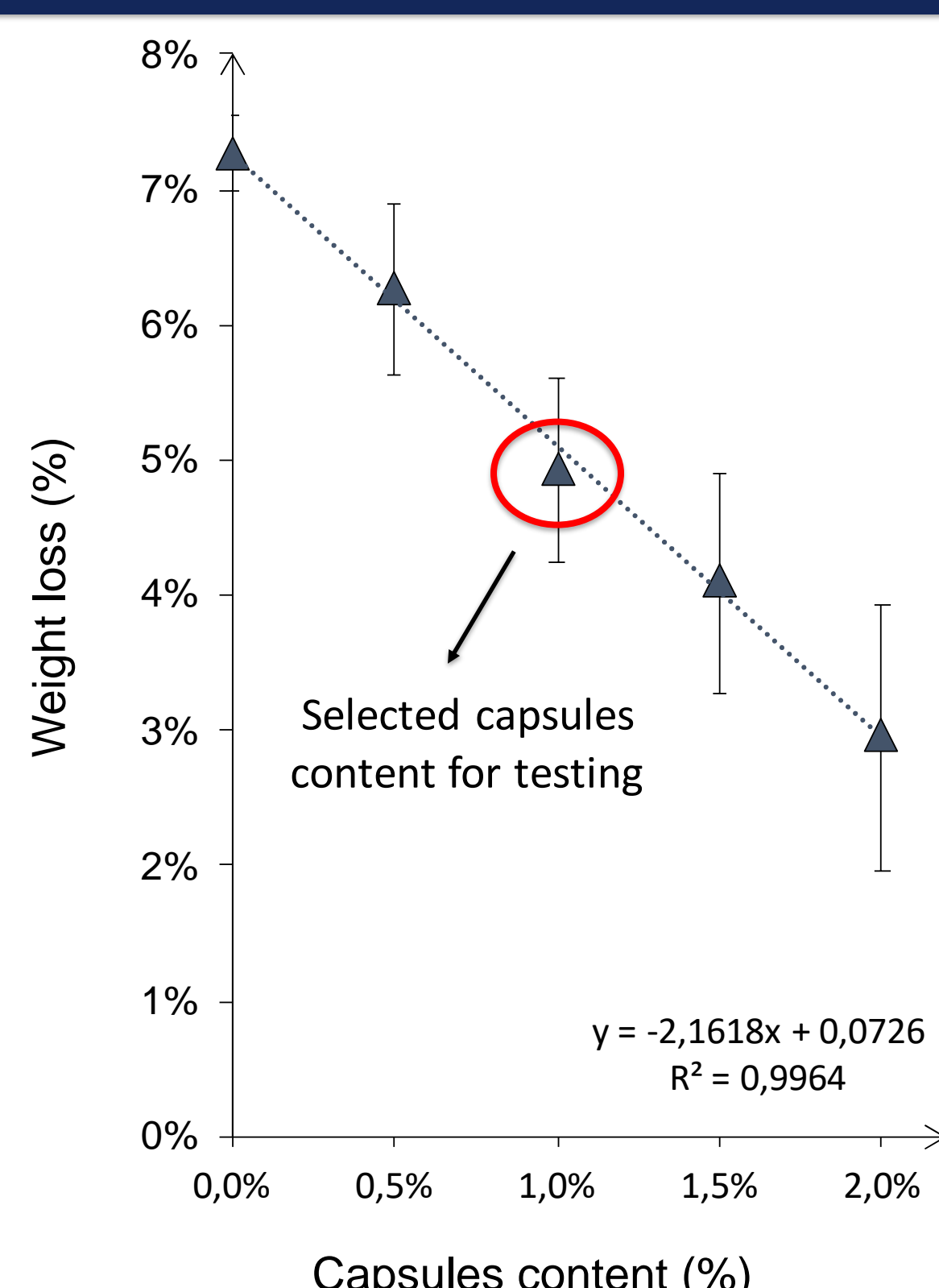


Figure 6. Weight loss over capsules content

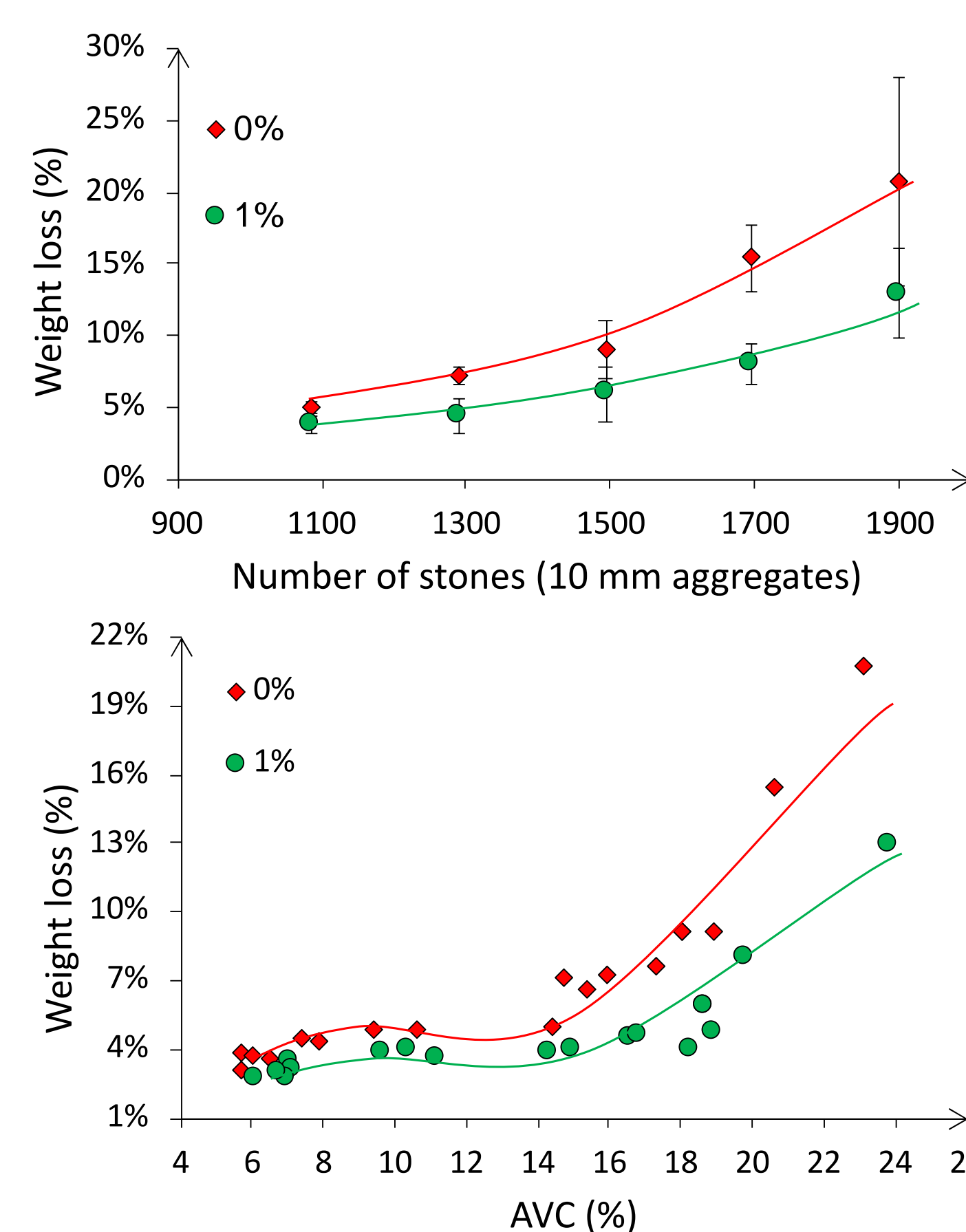


Figure 7. Influence of the gradation of asphalt on weight loss

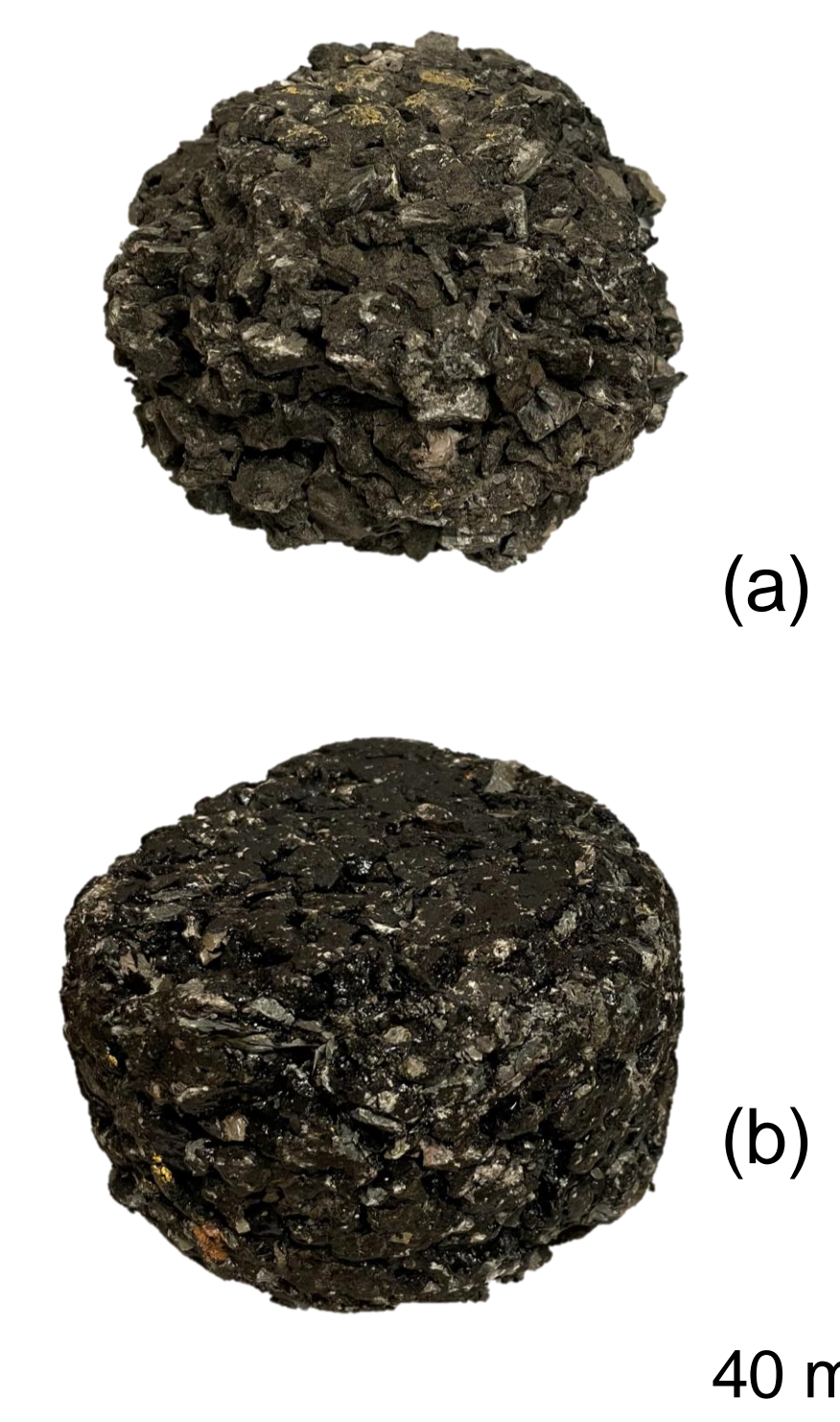


Figure 9. Cores after Cantabro: (a) Asphalt without capsules; (b) asphalt with capsules

## CONCLUSIONS

- There is a linear relationship between the mass loss and the content of encapsulated rejuvenators in the asphalt
- Based on results from Cantabro and Hamburg wheel tracker test, the optimum content of capsules that maximises their performance is 1%
- The performance of the capsules is dependant of the gradation of the asphalt, the grade of compaction and the air void content
- The lifespan of the asphalt is increased by 35% due to the action of the encapsulated rejuvenators

## References

[1] S. S. Adlinge. Pavement Deterioration and its Causes. IOSR Journal of Mechanical & Civil Engineering (IOSR-JMCE), pp. 9-15, 2009

[2] R. Hunter, A. N. Self y J. Read. Shell Bitumen Handbook (6th Edition). ICE Publishing, 2015

[3] Kuennen, Tom. Unraveling the mystery of asphalt raveling. Better Roads pp. 77, 2007

[4] J. De Visscher y A. Vanelstraete. Ravelling by traffic: Performance testing and field validation. International Journal of Pavement Research and Technology, vol. 10, n° 1, pp. 54-61, 2017

[5] J. Norambuena-Contreras, E. Yalcin, A. Garcia, T. Al-Mansoori, M. Yilmaz y R. Hudson-Griffiths. Effect of mixing and ageing on the mechanical and self-healing properties of asphalt mixtures containing polymeric capsules. Construction and Building Materials, vol. 175, pp. 254-266, 2018

[6] Dong, Q., Wu, H., Huang, B., Shu, X., & Wang, K. Investigation into laboratory abrasion test methods for pervious concrete. Journal of Materials in Civil Engineering, vol 25, n° 1, pp. 886-892, 2013