



## Combined research effort on aggregate road materials

Elena Kuznetsova (1), Inge Hoff (1), Svein Willy Danielsen (2), Børge Johannes Wigum (1), Marit Fladvad (1,3), Karlis Rieksts (1), Benoit Loranger (1), and Diego Barbieri (1)

(1) Norwegian University of Science and Technology, Civil and Environmental engineering, Trondheim, Norway (elena.kuznetsova@ntnu.no), (2) Geomaterials consultancy, Trondheim, Norway, (3) Norwegian Public Roads Administration, Trondheim, Norway

In European countries, the average aggregate consumption per capita is 5 tons per year (European Aggregates Association 2016), while the corresponding number in Norway is 11 tons (Neeb 2015). Due to the increased demand for sand and gravel for construction purposes, e.g. in road construction, the last decade has seen a significant trend towards the use of crushed rock aggregates. Neeb (2015) reports that half of the Norwegian aggregate production (sand, gravel and crushed rock) is used for road construction, and 33 % of the overall sold tonnage of crushed rock is exported. This resource has been more and more preferred over sand and gravel due to the significant technological development of its process and utilization phase. In Norway, the development and implementation of crushed aggregate technology has been the main approach to solve natural resource scarcity (Danielsen and Kuznetsova 2015).

In order to reduce aggregates transportation, it is aimed to use local aggregates and aggregates processed from rock excavations, tunneling, road cuts, etc. One issue focused in this research is the influence from blasting and processing on the final quality of the crushed aggregates, specifically relating to the properties for road construction purposes. It is therefore crucial to plan utilization of available materials for use in different road layers following the same production line. New developments and improved availability of mobile crushing and screening equipment could produce more sustainable and profitable sources of good quality aggregate materials from small volume deposits in proximity to construction sites. One of the biggest challenges today to use these materials is that the pavement design manual sets rigid requirements for pavement layers.

Four research projects are being conducted in Norway to improve the use of local materials for road construction. Four aspects are to be covered by the research: a) geological characteristics of the materials, their b) mechanical and c) thermal properties, and d) frost action and susceptibility.

The main goal of the PhD topic N1 is to achieve better utilization of aggregate resources through adjusting the production process according to local geological conditions and construction needs. The objective of the PhD project N2 is to look at the design stage and find the way to use these aggregates anyway by changing the road's design (e.g. increasing the thickness of asphalt layer). Fine particles content will also be harder to control due to rock type variability from site to site. Thus, PhD project N3 is going to investigate the effect of the increasing of fines and their mineralogy on frost action related problems during freezing and thawing seasons. Finally, PhD project N4 is investigating how the grading and mineralogy of the crushed rock material affects the heat exchange in road's granular layers and consequently, the frost penetration depth.

Combining these PhD studies we aim to create a holistic approach for a new understanding within this very complex area.