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Using carbon dioxide emissions as a criterion to award road construction projects: a pilot case in Flanders

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ABSTRACT

In the last decade, innovative technologies with regard to improved energy and material efficiency of asphalt pavement construction have been implemented by road industries. Two technologies are currently advocated: warm mix asphalt technologies and the increased use of reclaimed asphalt pavement. Unfortunately, these technologies were evaluated only by their technical and economic benefits and in most cases without an environmental impact study for the overall process. For encouraging the endeavour of the industry to implement newer – greener – technologies with focus to environmental benefit, the procuring authorities made an effort to enforce a sustainable approach for road works by the Project Carbon Free-ways. This pilot project included basic environmental parameters in the award criteria for public tenders on road works in Flanders. For this project two calculation tools, called Carbon Counter and Traffic Tool, were developed by the Flemish Agency for Roads and Traffic in order to estimate the carbon dioxide emissions of respectively the construction process and the traffic disturbance caused by the construction. The subject of this first public tender – with an evaluation of both tools – was the reconstruction of an asphalt road pavement in Kontich (Belgium). In this contribution the preliminary study on the methods of the tools and the main conclusions of the project are reported and discussed. The study illustrated that the current tendering process and the tools used, do have some limitations and drawbacks: the tools do not cover the total environmental impact as e.g. LCA do, the data concerning recycling or specific plant-related processes are outdated or missing and the data collection for back calculation of the total emission required too much manual efforts and shortcomings. Nevertheless, this pilot project proved to be a valued attempt to achieve more innovative and sustainable public procurement – as a first step, giving an unambiguous signal to the industry that this type of selection will be part of future tenders.

1. Introduction

The compulsory targets to reduce the greenhouse gases, initiated by the Kyoto protocol encouraged a search for innovative techniques. Various technologies have been developed by the road pavement industry in order to reduce the environmental impact: the use of reclaimed asphalt pavement; reducing the asphalt production temperatures; and concepts that prolong the service life of a pavement. According to the annual report Asphalt in Figures (European Asphalt Pavement Association, 2014) the total production of hot mix asphalt (HMA) and warm mix asphalt (WMA) in Belgium in 2013 totalling 5.3 million tons of which 51% contain reclaimed asphalt. In this way 61% of 1.5 million tons available reclaimed asphalt was used in HMA and WMA. According to the Flemish guidelines on best available techniques for asphalt plants (Leyssens et al., 2013), recycling reclaimed asphalt in asphalt is seen as the best solution in Flanders (a region within Belgium) to decrease waste disposal and use of natural materials.

The contracting pavement administrator has an important role by encouraging a more sustainable road infrastructure. Green public procurement (GPP) can be understood as "a process whereby public authorities seek to procure goods, services and works with a reduced environmental impact throughout their life cycle when

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compared to goods, services and works with the same primary function that would otherwise be procured" (European Commission, 2008). The European Commission (European Commission, 2014) stated that the criteria for GPP used by Member States should be equal to avoid distortion of the market and reduction of EU-wide competition; and to reduce the administrative burden. The EU GPP criteria for road construction (currently under revision) are formulated as guidelines rather than specific quantitative criteria (European Commission, 2010). Three core award criteria for GPP were defined: i) the use of secondary aggregates and recycled materials, ii) the durability and performance characteristics, and iii) the reduction of energy consumption through the life cycle. These three criteria are supplemented with four other, comprehensive GPP award criteria.

A Swedish investigation (Varnäs et al., 2009) found that both public and private clients in the construction industry take environmental impacts into consideration in their procurements, however, environmental criteria in tender evaluation are less common and seldom affect the award decisions. This trend is currently also been observed in Belgium, where until 2014 no environmental criterion was implemented in public tenders for road construction. As summarized by Testa et al. (2014), the main obstacles limiting the uptake of GPP, are the lack of organizational resources for political support, the limited information on the real environmental impact of the products, the difficulties in preparing calls for tenders and purchasing, the absence of guidelines from general authorities and a non-coordination between authorities.

The Dutch Department of Public Works within the Ministry of Infrastructure and the Environment, Rijkswaterstaat (RWS), implements monetised environmental award criteria in their public procurement for road construction by using two different tools (van Geldermalsen, 2013, 2014). DuboCalc converts life cycle environmental impacts in 11 areas (using a life cycle assessment (LCA) database), into an environmental cost indicator (ECI) value. The CO_2 performance ladder is used to assess the efforts of a company to reduce carbon dioxide (CO_2) emissions caused by the project. The supplier chooses a level of ambition, with each level yielding a 1% reduction of the submission price. The project is awarded to the supplier with the lowest adjusted quoted price.

The Flemish Agency for Roads and Traffic (ART), in collaboration with the Dutch and British Highways Agencies, considered methods that can reduce CO_2 emissions from road works. These agencies agreed on three evaluation criteria for road construction: procurement, street lighting and construction of the road. The Flemish ART started a pilot project called Carbon Free-Ways, where the reduction of CO_2 emission of the road work was an award criterion for the public tender, together with the price.

Since 2013, the European Union Emission Trading System (European Union, 2013a) covers all installations with a net heat excess of 20 MW. For Flanders (Departement Leefmilieu Natuur en Energie, 2014), 220 installations were subjected to the emission trading system in 2013, together emitting approximately 40% of the greenhouse gas emissions. For the asphalt production sector, 13 of the 19 plants are subjected to this system, representing 43,269 tons CO_2 equivalent or 0.13% of the registered CO_2 equivalent emissions in Flanders.

2. Pilot project Carbon Free-Ways: objective and approach

The objective of the pilot project Carbon Free-Ways was to stimulate CO_2 efficient working methods for road construction. The authors want to emphasize that taking into account only CO_2 emissions, will lead to a significant underestimation of the full environmental impact by excluding impact categories such as fossil depletion, land use, human and ecotoxicity, ionising radiation, eutrophication, particulate matter, etc. (European Union, 2013b). The public tender for this road work, executed in May 2014, included: milling and repaving a test section on a Flemish primary road (N171 in Kontich); applying road markings; providing traffic management; and the maintenance of the work during the three year warranty period. The test section was 1 km long, consisting two lanes and a paved emergency lane in each direction. The work, monitored in the context of the pilot study, included repaving the base (7 cm) and top (3 cm) layer of the test section.

2.1. Operation procedure of the pilot

Presently, for all public works, the tender price is the standard (sole) award criterion. In this pilot project the tender was evaluated by price for 50% and by CO_2 emissions for the other 50%. The score for the price (maximum 50 points) was calculated with equation (1).

$$score\ price = 50 - 25 \times \left(\frac{P - P_{min}}{P_m - P_{min}}\right) \quad (1)$$

With: P: project price of the contractor in euro;

P_{min}: lowest price of all applicants;
P_m: arithmetical average of the prices from all applicants.

Two different tools were developed by the Flemish ART in order to calculate the theoretical CO_2 emissions based on measurable data. All contractors, applying for the public tender, were forced to use these two tools to calculate the emissions. The Carbon Counter (original Dutch name: '*Koolstofteller*'), accounting for a weight of 30% in the judgement, was used to calculate the emissions from the asphalt production, the transport of materials and the production of the raw components of the asphalt mixture. The score for the Carbon Counter (maximum 30 points) was calculated with equation (2).

$$score\ Carbon\ Counter = 15 + \frac{15}{0.25} \times \left(1 - \frac{CO_{2,kt}}{CO_{2,kt,m}}\right) \quad (2)$$

With: $CO_{2,kt}$: tons of CO_2 produced (the Carbon Counter result);

$CO_{2,kt,m}$: arithmetical average of the Carbon Counter results from all applicants in ton.

The Traffic Tool, which counted for 20%, was used to calculate the extra emissions due to the disturbance of the traffic. The score for the Traffic Tool (maximum 20 points) was calculated with equation (3).

$$score\ Traffic\ Tool = 10 + \frac{10}{0.25} \times \left(1 - \frac{CO_{2,tt}}{CO_{2,tt,m}}\right) \quad (3)$$

With: $CO_{2,tt}$: tons of CO_2 produced by disturbed traffic (the Traffic Tool result);

$CO_{2,tt,m}$: arithmetical average of the Traffic Tool results from all applicants in ton.

$$total\ score = score\ price + score\ Carbon\ Counter + score\ Traffic\ Tool \quad (4)$$

The contractor was selected based on the application with the highest total score (equation (4)).

Measurable and verifiable parameters were reported and used by the contactor as input data for the assessment of the CO_2