EAPA

The use of secondary materials, by-products and waste in asphalt mixtures

Position Paper

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1. Introduction

Half of total greenhouse gas emissions and more than 90% of biodiversity loss and water stress come from resource extraction and processing. As a reaction, the European Commission published at the end of 2019 the European Green Deal[1], launching a concerted strategy for a climate-neutral, resource-efficient and competitive economy. In it, it is explained that scaling up the circular economy from front-runners to the mainstream economic players will make a decisive contribution to achieving climate neutrality by 2050 and decoupling economic growth from resource use, while ensuring the long-term competitiveness of the EU and leaving no one behind.

This adds to previous legislative documents, such as the Directive 2008/98/EC on waste, and Directive 1999/31/EC on the landfill.

According to Eurostat[2], in 2016, the total waste generated in the EU by all economic activities and households amounted to 2.261 million tonnes. Slightly more than a half (52.6 %) of this was treated in recovery operations: recycling (36.7 % of the total treated waste), backfilling (10.1 %) or energy recovery (5.8 %). The remaining 47.4 % was either landfilled (40.3 %), incinerated without energy recovery (0.8 %) or disposed of otherwise (6.3 %). Therefore, it can be said that the European Union's economy currently loses a significant amount of potential secondary raw materials which are found in waste streams.

The problem is getting even worse, as described in the New Circular Economy Action Plan, also published by the European Commission in March 2020, in which it is foreseen that the annual waste generation will increase by 70% by 2050[3].

Moreover, it is also explained that for the specific case of the built environment, vast amounts of resources are required, accounting for about 50% of all extracted material. The construction sector is responsible for over 35% of the EU's total waste generation[4] and the Greenhouse gas emissions from material extraction, manufacturing of construction products, construction and renovation of buildings and infrastructures are estimated at 5-12% of total national GHG emissions[5]. Hence, it is estimated that greater material efficiency could save 80% of those emissions[6].

One of the common hurdles to recycling and re-using waste in the EU is the lack of confidence in the quality of recycled materials. There is also uncertainty about the potential health risk for workers using recycled materials.

The asphalt industry has already built up an important record in re-using or recycling old asphalt pavements and in using several other waste materials as a secondary raw material (recycled aggregates etc.) into new asphalt. In doing so, the industry has gained experience on the huge possibilities, but also on limitations that exist. Furthermore, the asphalt industry has expressed on several occasions that asphalt should never go to landfill and should never be seen as a product to solve the waste stream problems of other industries. Thus, the European Asphalt Pavement Association recommends that the first priority be given to the reuse of reclaimed asphalt into hot and warm mix asphalt as this represents a very significant potential to save on the overall consumption of bitumen and energy in Europe.

Secondly, EAPA recommends that waste, or waste derived materials offered to the asphalt industry can only be incorporated into asphalt if it can be shown through a Risk Assessment process that there are no disadvantages with respect to health and safety of workers and the general public, to environment, to re-usability and recyclability, and to technical performance during processing, use and application, now and in the future.

This industry statement has been developed, to positively contribute to the discussion on the possibilities and limitations for the use of waste from other industries in new asphalt mixtures.

2. Asphalt industry in Europe

The European Asphalt Pavement Association (EAPA) is the European industry organisation representing manufacturers of bituminous mixes and asphalt as well as companies engaged in asphalt road construction and maintenance. EAPA has 40 members and associate members. There are two types of members:

- Members (National Associations)
- Associated members (Companies located in Europe, India, the USA and Russia)

At this moment, the members (national industry associations) originate from 15 European countries:

Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Hungary, Ireland, Norway, Slovenia, Spain, Sweden, Turkey and United Kingdom.

In Europe, approximately 300 million tonnes of hot and warm mix asphalt were produced in 2018. Asphalt is a mixture of aggregates, sand, filler, the bitumen binder and occasionally several additives. Today more than 90% of the 5,5 million kilometres of roads in Europe are made of asphalt material.

Along the years the asphalt mix has become a highly technical product, using strictly specified materials under rigorous quality assurance programmes; for instance the tolerance for the aggregates are often less than 5% for the shape, size, hardness, wear index, etc., while the variety of mix types is itself almost limitless: depending on its position in the road structure (base or surface course, for example), on its particular function (intensity of traffic, anti-skid properties, noise reduction, etc.), on climatic conditions (from freezing to high temperatures) and on the nature of raw materials locally available (limestone or granite quarries, types of bitumen etc.). It is a carefully engineered product in order to be successful in its use phase.

Now, in Europe there are approximately 4.500 asphalt mixing plants, more than 10.000 companies are producing and/or paving asphalt, 180.000 people working in the asphalt industry and the industry has an estimated turnover of roughly 30 billion Euro.

In an increasing number of countries reclaimed asphalt and/or demolition waste is reused/recycled to replace virgin aggregates and part of the binder, e.g. 50 million tonnes of reclaimed asphalt are available per year, of which approximately 20% is recycled and 76% is re-used. A clear distinction should be made between recycling and re-use: According to the Directive 2008/98/EC on waste (Waste Framework Directive):

- 're-use' means any operation by which products or components that are not waste
- are used again for the same purpose for which they were conceived;
- 'recycling' means any recovery operation by which waste materials are reprocessed
- into products, materials or substances whether for the original or other purposes. It
- includes the reprocessing of organic material but does not include energy recovery and
- the reprocessing into materials that are to be used as fuels or for backfilling operations.

The following waste hierarchy shall apply as a priority order in waste prevention and management legislation and policy:
(a) prevention;
(b) preparing for re-use;
(c) recycling;
(d) other recovery, e.g. energy recovery; and
(e) disposal.

3. Scope

The asphalt industry strongly supports all efforts to increase the percentages of reclaimed asphalt into new asphalt mixtures. It is the aim of the industry to reuse reclaimed asphalt at the highest possible level. This is economically (because of the reuse of the bitumen as well as the aggregates) and environmentally desirable.

Road construction is a high-volume processing industry and, as such, has attracted the attention of some regulators as a potential disposal route for some types of waste material. Waste legislation is complex however and the beneficial recycling of waste is similarly complex in respect of hazard classification and risk assessment.

Because of the increasing difficulty of disposal of waste to landfill, producers of waste look to high volume industries such as the road construction industries to assist in the disposal of waste streams, or products recovered from waste streams. Furthermore, there is often an economic driver for the use of waste derived products.

More recently, issues have emerged about other additives which may have been included at one time or another, in one country or another in specialty asphalt mixes, key among them are tar and asbestos. The industry strongly supports initiatives to identify such additives containing such mixes, in order to reject them from the hot recycling/hot re-use material streams when the nature and concentration of such additives represent an unacceptable risk in terms of impacts on workers' health, environment, future recyclability, etc.

This EAPA position statement is intended to provide an industry position on the inclusion of waste and waste derived products (such as by-products or waste streams that have been "cleared" through the end-of-waste procedure) into new bituminous mixtures (asphalt).

4. Reclaimed Asphalt (RA)

The use of Reclaimed Asphalt (RA) in the production of new asphalt mixtures is probably the most common application of reuse. This application is widely used in most countries and has grown significantly over the last 25 years with Reclaimed Asphalt (RA) content varying from 10 to 90 % depending on mixture designs (sometimes up to 100% in some cold mix designs).

However, in Europe RA containing coal tar (over 50 mg/kg), a legacy from twentieth century practices, is classified as hazardous waste and should not be re-used using a hot process. Today, asphalt mixtures are made with bitumen but, in the past, coal tar and other tar distillates were used, which has left the troublesome legacy of high PAH content in some asphalt pavement mixtures considered for recycling and/or re-use. In some countries coal tars coming from brown coal (pit coal) were used and this type of coal tar has a relatively low PAH content, but a relatively high phenol content. The industry strongly supports European initiatives to identify RA containing such materials, in order to reject them from the hot recycling/hot re-use material streams when the PAH concentration exceeds 50 mg/kg. For more information see Annex 1.

5. Substitution

Probably the most common use for hot bituminous mixtures in conjunction with waste materials is substitution of a proportion of the binder, or aggregate fraction of asphalt with a (former) waste or waste derived material. This application potentially includes an immense range of materials, examples of which include (but are not limited to);

- Foundry sand
- Recycled aggregates
- Recycled glass
- Recycled plastic
- Recovered roofing membranes and shingles
- Shredded tyre rubber (crumb rubber)
- Spent catalyst fines
- Various kinds of slags
- Various kinds of fly ash (power plants),

The above list is not exhaustive and many other applications exist in addition to other new applications which might arise in the future. However, there are in some cases added performance benefits from these materials, which need to be carefully considered and thoroughly engineered.

6. Risk Management

The use of bitumen or asphalt as a medium in which waste streams can be recycled presents social and business opportunities. It is a key environmental benefit provided by our products and industry which must be maintained.

With the use of secondary materials, by-products and waste in asphalt mixtures conflicts of interests are likely to occur. It is possible or even likely that on one hand an advantage for using these materials could cause on the other hand a disadvantage – e.g. the case of roofing materials, where the included bitumen may save CO2 by substituting virgin bitumen, but the type of bitumen or other ingredients might cause a risk for the health of the worker at certain applications.

The reasons for using secondary materials, by-products and waste in asphalt mixtures should be considered. Before using those materials in asphalt, it should be clarified what the purpose is: does it substitute a vital ingredient 1:1, does it improve properties and hence the quality of the asphalt? Or is it a way to get rid of secondary materials, by-products and waste in a way, which will not harm and endanger the properties of asphalt? In many cases, there might be a combination of the three, but the purpose should be an important point when considering the result of the necessary risk assessment.

The use of non-traditional materials in bituminous applications carries with it several potential risks, in particular for waste streams that may have been classified as hazardous. Because waste is an environmental issue with an extremely high degree of sensitivity, liabilities and risks involved in waste disposal and/or recycling must be viewed and assessed very carefully. Public attention in this area adds a dimension that requires diligent assessment of the implications of using waste materials in these types of application.

Secondary materials, by-products and waste should only be incorporated into bitumen / asphalt if it can be shown that:

- There are no disadvantages with respect to health and safety of workers and the general public during processing, use and application, now or in the future.

- There are no environmental impacts and/or liability problems at the time of use, or in the future.
- There is no significant negative impact on the technical product performance of asphalt.
- The value for money analysis remains highly positive for the clients, considering possible technical performance issues, such as the need to lay-down thicker layers for the same performance.
- The introduction of waste should not affect the competitiveness of asphalt solutions versus alternative pavements.

In the past, inclusion of various additives, products or waste into asphalt has sometimes led to difficulties with the reusability/recyclability and/or environmental impact of such modified asphalt mixtures. Legislation requires that producers of bitumen or asphalt products must assess the HSE hazards and risks of the products they supply. To be aware of potential HSE impacts of ingredients, **the industry recommends the systematic use of the product safety and environmental data sheet,** provided by the suppliers and generators of such additives or substitute materials.

7. Risk Assessment

A Health, Safety & Environmental risk assessment should be carried out prior to accepting a waste stream or waste derived material for inclusion into bituminous mixtures. There are four key issues which need particular attention in a risk assessment of waste materials for use in bitumen / asphalt:

- **Type of waste** - i.e. **the classification of the waste; how dangerous and harmful it is towards health and the environment now, or in the future?**
- **Mechanical risks** - i.e. **the ability of the bitumen to contain the waste material when subjected to mechanical shock, abrasion, natural phenomena, e.g. water immersion etc.**
- **Chemical/physical risks with bitumen** - **the specific reactivity of the waste with** bitumen and conceivable effect such reaction might have on health or the environment. Also, the behaviour of the waste under bitumen/asphalt processing, use and application conditions
- **Lifecycle Health and Environmental risks** - **Risks arising during the finite lifetime of, e.g. a road pavement, and the end-of-life considerations, i.e. re-use, recycle, disposal of the product.**

Assumptions that make an application appears viable today might be different in the future. In this context, it is essential that testing programmes be carried out using 'state of the art' techniques. Furthermore, as knowledge in the use of bitumen in waste handling applications develops it might be necessary to review the risks of existing applications and advise owners of waste on newly discovered issues. Thus, the evaluation of residual risk is a key aspect of the commercial assessment of a potential business opportunity.

As an example, here are some indications of the main risks encountered with the list from the above substitution paragraph:

- Foundry sand: heavy metals, phenols, PAHs
- Recycled glass: glass additives
- Recycled plastic: chlorinated compounds
- Recovered roofing membranes and shingles: (severely) oxidized bitumen, asbestos, various additives, PAHs
- Shredded tyre rubber (crumb rubber): PAHs, benzothiazole, various additives
- Spent catalyst fines: heavy metals
- Various kinds of slags: heavy metals
- Various kinds of fly ash (power plants): (heavy) metals, sulphates

8. Conclusions

The waterproofing and inert nature of bituminous materials makes them a potentially useful material for use in a wide variety of applications involving re-use or recycling of waste streams. However, potentially large liabilities may arise from the use of asphalt in applications where failure of the product, or process might lead to damage to health or the environment.

EAPA recommends that the first priority be given to the re-use of RA into hot and warm mix asphalt as this represents a very significant potential to save on the overall consumption of aggregates and bitumen in Europe.

Secondly, EAPA recommends that waste, or waste derived materials offered to the asphalt industry can only be incorporated into asphalt if it can be shown through a Risk Assessment process that:

- There are no disadvantages with respect to health and safety of workers and the general public, during processing, use and application, now or in the future.
- There are no environmental impacts and/or liability problems during processing, use and application, now or in the future.
- The future reuse and recyclability of asphalt is not endangered.
- The value for money analysis remains positive for

our clients.

- There is no negative impact on the technical product performance of asphalt now or in the future.
- The introduction of waste should not affect the competitiveness of Asphalt solutions versus alternative pavements.
- That the health an environment classification of bitumen or asphalt is not affected by the addition of the waste.

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Annex 1 - Case of old pavements containing tar

There is a general confusion between tar and bitumen. The two products however are quite different: tar is the result of the distillation of coal, while bitumen is the result of the distillation of crude oil.

Tar was used predominantly in the past, while only bitumen is now used for asphalt mixtures in Europe. One of the reasons for abandoning tar, despite its good technical performances, was its impact on human health due to its high contents in carcinogenic PAHs (Polycyclic Aromatic Hydrocarbons) and/or phenol. Other tar distillates (lighter oils) have also been used as additives and have been improved continuously in order to keep up with stricter regulations on PAHs content.

In case of asphalt containing tar, the waste is considered hazardous and the hot recycling is not allowed. If a reclaimed asphalt contains more PAH's and/or phenol than a certain limit value, it is considered as "asphalt containing tar". In some countries it is allowed to rely on cold techniques with or without binders (bitumen emulsion, foamed bitumen, and/or hydraulic binders).

The definition of 'asphalt containing tar' can differ from country to country because there are different limits in several European countries. These limits are mentioned in the national legislation. Beside that there is a definition in the EURAL waste list: Reclaimed Asphalt containing more than 0,1 % coal tar should be regarded as hazardous waste.

The Working Document of the Commission services on landfill of waste states that bituminous mixtures considered as inert waste may include no more than 25 mg/kg PAH. ("Criteria and procedures for the acceptance of waste at landfills", Committee for the adaptation to scientific and technical progress of EC-legislation on waste, March 2002).

For the identification of the possible presence of tar before the recycling/re-use of reclaimed asphalt, a number of best practices are recommended:

- Identify the history of the construction of the road section considered for excavation or milling. It is the responsibility of the road owner to provide the information, as per the general responsibility of any potential generator of polluted material. Usually this research will provide a very useful insight on the probability of finding tar on a particular project.
- Before beginning the project develop a two-tier testing plan relying on a few complete laboratory tests supplemented by semi-quantitative field methods.
- The semi-quantitative methods available in Europe are usually reliable at thresholds that are sufficient to identify tar containing layers in pavements that register in the 10s of thousands mg/kg PAH.

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