Asphalt Rubber - a new concept for asphalt pavements in Poland

Adam Bisek
BISEK INDUSTRIES INC.,
ul. Strachowicka 42a
54-512 Wrocław , Poland
abisek@onet.eu

ABSTRACT. More and more roads in the US and Europe are built in the rubber asphalt technology. The name of the rubber asphalt means bituminous mixtures modified with rubber granulate Technology of bituminous mixtures modified with rubber granulate comes from the United States, where it has been used for more than 30 years. BISEK Company, after several years of cooperation with Wroclaw Technology University and Clemson University of South Carolina (USA), introduced asphalt mixtures modified with rubber granulate into the production and rubber asphalt roads are built in Poland since 2006.

During this six years many sections of new covers were performed in Poland, Czech Republic and in Quebec (Canada). Paper presents results of practical use of different mixes (SMA, SAMI and Mastic Asphalt) on the base of rubber modified bitumen (wet process) with content of 14% - 16% of crumb rubber in bitumen. Pavements based on rubber-modified asphalt are more resistant to cracking, have better adhesion at the interface between the vehicle wheel and the surface, and at the same time they are quieter. Innovative surfaces built with bituminous mixed with rubber have increased flexibility, roughness and durability of the top layer, do not get rut, and most important they have a significantly shorter braking distance. Other advantages of asphalt rubber roads called "safe routes" is high frost resistance, the ability of glazed frost fast removal, resistance to environmental factors such as water and air and reduction of light reflection, thus directly increase the level of safety in road traffic.

KEY WORDS: *rubberized asphalt , asphalt rubber blender, paving*

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1. Introduction

Asphalt-rubber binder is increasingly used in road and the airport runway paving. The pioneer technique of obtaining rubber from scrap tires was first used in 1966 in Arizona, by Charles H. McDonald. He observed that the asphalt mixed with rubber in the heating process, increases the binder flexibility. Thus modified mixture was used to repair local asphalt damages: cracked trailer and railcar roofs used by the U.S. Bureau of Public Roads. Since then, the technology of asphalt modified with rubber has become more popular although it is most successful in the U.S. where 8 states regularly use mixtures based on rubberized asphalt binder. In Europe, the mixtures with rubber fines are produced in Portugal, Italy, Sweden and for 7 years in Poland. First attempts to apply rubber fines to the modification of mineral-bituminous mixtures took place in the laboratory at the Technical University of Wroclaw in 1995. The results of those tests failed. After ten years, due to cooperation with American universities (Clemson University - South. Carolina), the technology of asphalt modification with rubber was back in practical application. The effect of rubber modification of mineral mixtures depends on the technology of mixing asphalt with rubber, the nature and properties of granulated rubber used, the quantity of added granules, the type of asphalt and the technology of paving. Since 2006 over 100 000 m^2 of asphalt-rubber pavements have been successfully laid using SMA mixtures and the SAMI technology.

2. First equipment implementations

Since 2001 I visited a number of American companies to learn technology of both rubber asphalt devices and road paving. It was good time of training and gaining experience. In the year 2004 Bisek Industries started cooperation with American Company Phoenix Industries. We cooperated with Phoenix Industries over asphalt rubber blender. It was our joint-venture. They provided initial design of an asphalt rubber blender that we were going to manufacture in Wroclaw. So we did, at the same time we introduced several important corrections. The result of that cooperation was a new asphalt and rubber blender that fit into European road construction needs, since American constructions were too large for that market. For example Bisek machines were used in Poland, Sweden, Canada, Czech Republic and Puerto Rico.

Figure 1. *Mobile asphalt rubber blender under construction, Krępice, Poland*

Figure 2. *Mobile asphalt rubber blender, Krępice, Poland*

Figure 3. *Bisek blender in Victoriaville, Canada, 2009*

For the moment we have manufactured a rubber asphalt blender of next generation - an entirely new blender design - in which we implemented new solutions. It's a device of a different size and more effective. That blender allows the production of 240 t/h, at the same time reducing exploitation cost by some 20 %.

3. Examples of rubber asphalt implementation

In Poland, the first practical application of asphalt-rubber binders produced in "the wet process " took place in Wroclaw in 2006. Old surface of Przybyla street made of concrete slabs with numerous transverse cracks, were covered with a 4cm layer of SMA 0/11mm based on asphalt modified with rubber. For preparing the SMA the basalt aggregate with lime filler were used. The grading of SMA meet the Polish requirements as show in the figure 1**.** That was SMA with asphalt 50/70 and 14 % of rubber.

After five years of operation, the surface behaves very well. Noise level measured in 2009 indicates that the surface is about 3dB quieter than the laying next to it wearing layer made of traditional asphalt. The process of incorporating

asphalt-rubber mixture is similar to the traditional mixture but with maintaining a little bit higher temperature.

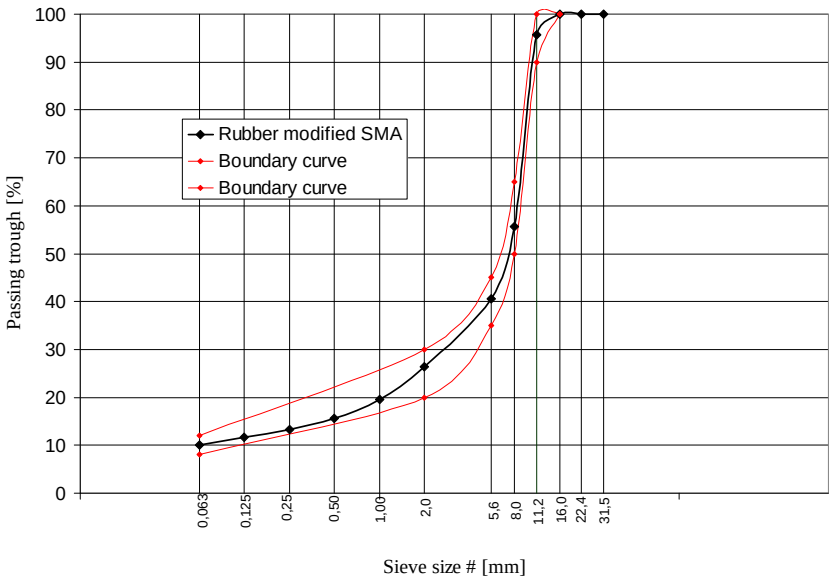

Figure 4. *Grading curve of S M A aggregate mixtures*

For many years Bisek Industries has been collaborating with Wroclaw Technology University both in designing new machines for road construction and testing new paving technologies. A result of that cooperation was rubber asphalt road section paving within the Technology University campus (Fig.6).

One of the results of Bisek Industries cooperation with the Wroclaw Technology University was technology of SAMI – stress absorbing membrane interlayer – production and laying. The other result was the technology of Mastic Asphalt on the base of rubber asphalt with the use of both wet and dry technologies at the same time.

An effective experience with rubber asphalt took place in Victoriaville, Canada, 2009. Bisek Industries provided rubber and asphalt mixer and paving technology. The work was completed in 2009 by Bisek manpower (fig. 7-10).

Figure 5. *Przybyly Street, Wroclaw, Poland, after 6 years of paving with SMA and asphalt modified with rubber.*

Figure 6. *Wroclaw University of Technology, inner road paved with rubberized asphalt, 2008.*

Figure 7. The road surface before renewal, Victoriaville, Canada, 2009.

Figure 8. During the paving with rubberized asphalt, Victoriaville, Canada, 2009

Figure 9. After the paving with rubberized asphalt, Victoriaville, Canada, 2009

Figure 10. Road surface paved with rubberized asphalt, Victoriaville,Canada, 2010

4. Advantages of using bitumen modified with rubber

The main advantages of using bitumen modified with rubber for road layers come from:

- more durable roads and airport bituminous surfaces compared with traditional asphalt,
- layers are resistant to thermal and mechanical cracks,
- coverage are more resistant to permanent deformations - ruts,
- wearing layers based on rubber modified bitumen have a much better grip with the tires (shorter braking distance),
- surfaces are less noisy, a few to several decibels,
- reduction of the environmental pollution by recycling of used tires,
- lower cost of the surface maintenance during summer and winter.

New coverage of bitumen are particularly recommended where traffic intensity is greatest, and there is trouble with the proper maintenance of roads, in particular:

- road surfaces with a high traffic of heavy load vehicles,
- junctions and intersection approaches,
- as a cover of old damaged and cracked concrete pavements,
- coverage of old stone pavement,
- surfacing of the runways and taxiways at the airports,
- as a pavement in areas that are being subject to large deformations, eg. mining damages.

5. Summary

The use of rubber granulate for the modification of asphalt dramatically improves the properties of mineral-asphalt mix.
Pavements based on rubber-modified asphalt are more resistant to cracking, have better adhesion at the interface between the vehicle wheel and the surface, and at the same time they are quieter.

The environmental aspect is also important. Through the recycling of old tires and use of rubber granulate, we get rid of environmentally troublesome waste. Layers of mineral-asphalt mix based on rubber-modified asphalt, thanks to their high

flexibility, can be successfully applied where there is a substantial ground deformation (eg, mining damage).

6. References

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