# Handling of railway superstructure material at the end of the life cycle

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## INTRODUCTION

The network of railway lines managed by the Railway Administration, a state organization in the Czech Republic, is currently approximately 9,400 kilometres long. These lines form 15,300 kilometres of tracks, including almost 22,000 switches. The vast majority of this railway network has conventional construction of railway superstructure, i.e. a rail grate placed in a gravel railway bed [3].

Using a very rough calculation, we can estimate that the railway beds of the railways managed by the Railway Administration, state organization (hereinafter referred to as the Railway Administration) and other railways operated by the Railway Administration, s.o. (hereinafter referred to as the railways of the Czech Republic) consist of 30 million m3 of aggregates, which represents about 54 million tons.

## PAST

If we wanted to replace all the aggregates of the railway bed with new ones as part of the modernization of the railway network, it would mean an enormous use of the highest quality irreplaceable natural resources of aggregates and the devastation of the landscape associated with that.

This is why in 1994–1995 specialists from the then Czech Railways Transport Division, in cooperation with other interested experts from construction companies and the field of geotechnics, focused on determining, verifying and announcing the conditions and rules for the recycling of railway bed aggregates. Ing. Mojmír Nejezchleb, CSc. from VÚŽ, Ing. Miroslav Šolc from the Technical Central Office of Infrastructure, Ing. Miroslav Hörbe older from the Stone and Aggregate Testing Laboratory in Hořice, Ing. Milan Kovář from the company SG-Geotechnika Praha, Ing. Aleš Suchánek from ŽSD, Mr. Pavel Čupr from the Technical Central Office of Infrastructure, RNDr. František Žižka from the Prague Construction Administration and many others participated in this work. The task was also solved in cooperation with the Railways of the Slovak Republic, represented by Ing. Miroslav Havrila [1].

Fig. 1 Mc Closkey sorting machine in action, photo Halík M

## PRESENT

In 2002, EN 13450 standard "Aggregates for Railway Beds" was adopted by the European Committee for Standardization [7]. This standard was subsequently taken over into the system of Czech technical standards, where it replaced the original standards ČSN 72 1511 [8] and ČSN 72 1512 [6], together with other adopted European standards. The common European product standard for railway bed aggregates already foresees the use of aggregates recycled from the existing railway bed. The adoption of the European standards did not bring fundamental changes in the parameters of aggregates, but in the way of their verification. The acceptance of a single European testing system meant the need to equip the test laboratories with new aggregate testing equipment. The properties of the aggregate determined according to the test procedures valid until that time were fully satisfactory. However, a large number of comparative tests had to be performed in order to select the appropriate standard categories determined by the new test methods. Most of the Czech testing laboratories and aggregate producers took part in this process, providing the necessary test samples for this comparison. Following the publication of the European standard, new General Technical Conditions (GTC) "Aggregates for Railway Beds" have been issued. These GTCs determine which optional properties and value categories specified in ČSN EN 13450 must be tested and declared when offering new and recycled aggregates for railways and switches of railway lines of the Czech Republic [7].

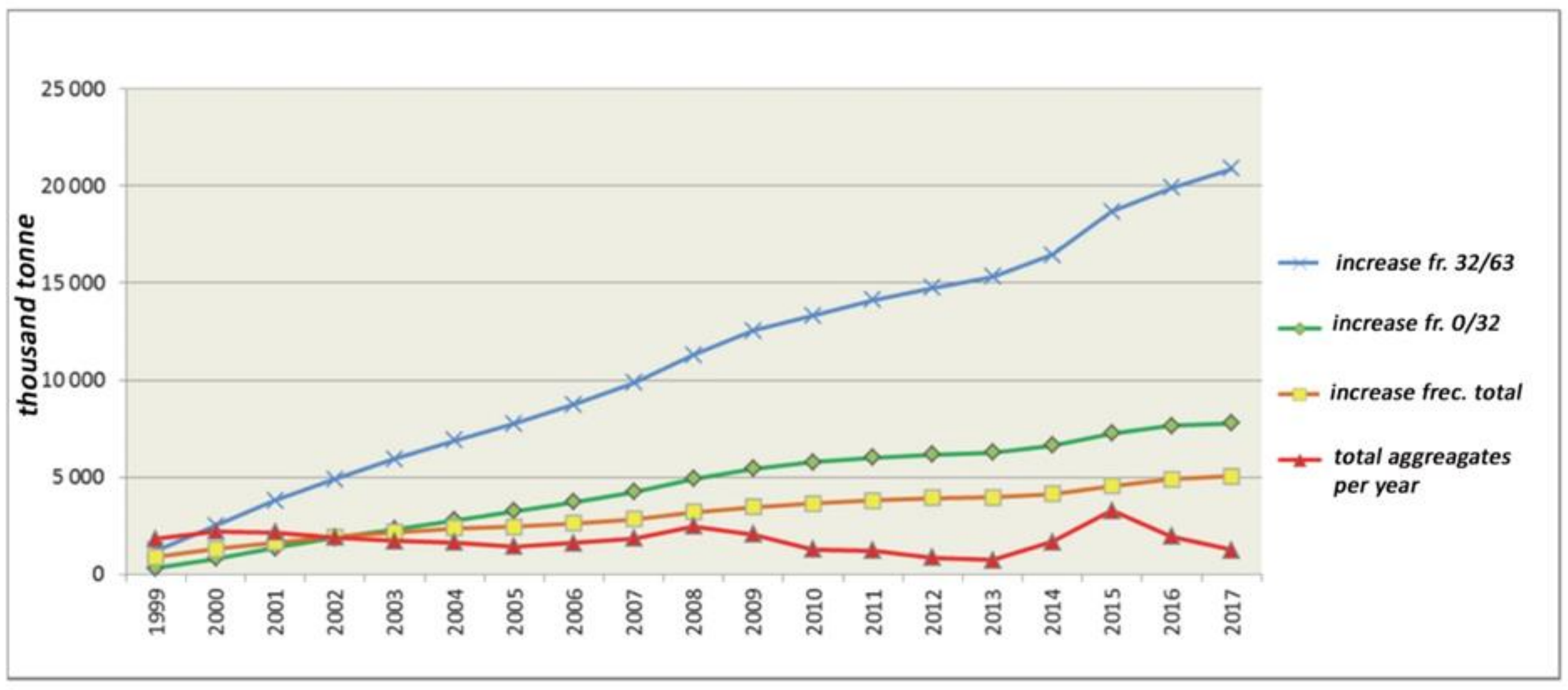


Fig. 2 Overview of aggregate recycling in 1999 - 2017 [1]

## EXTRACTABILITY

Tab. 1 illustrates the results of extractability tests and their comparison with the limit values of permissible concentrations of pollutants in dry mass of waste according to Table No. 10.1 of Annex No. 10 to Decree No. 294/2005 Coll., on the conditions for depositing waste in landfills and their use on the terrain surface and amendment of Decree No. 383/2001 Coll. on the details of waste management. A sample of aggregate K101 was taken from the section of the Pilsen-Cheb line, sample K102 was taken from the line Pilsen - Domažlice line and sample K103 was from the Vlečka Škoda line.
The results of the extractability analyzes show that pollution can occur in various forms. The most common are petroleum substances, PAHs and heavy metals. Even if the material complies with the extractability classes for landfilling, we must use Table No. 10.1 and 10.2 of Annex No. 10 of the Decree in the case of the use of such treated waste, because we will use the product on the terrain surface.

Tab. 1 Contaminant content of aggregate samples from railway bed

| Representative sample: | K101 | K102 | K103 | Limit value * (in mg/kg of dry mass) |
|---|---|---|---|---|
| Metals | | | | |
| As | 52.300 | 75.600 | 29.800 | 10.000 |
| Cd | 10.900 | 22.900 | 1.340 | 1.000 |
| Cr total | 169.000 | 232.000 | 78.500 | 200.000 |
| Hg | 0.363 | 0.502 | 0.264 | 0.800 |
| Pb | 453,000 | 851,000 | 105,000 | 100,000 |
| V | 120.000 | 124.000 | 61.400 | 180.000 |
| Monocyclic aromatic hydrocarbons (non-halogenated) | | | | |
| Sum of BTEX | <0.050 | <0.050 | 0.512 | 0.400 |
| Polycyclic aromatic hydrocarbons | | | | |
| Sum of PAU | 10.500 | 7.840 | 28.500 | 6.000 |
| Chlorinated aliphatic hydrocarbons | | | | |
| EOX | <1.000 | <1.000 | <1.000 | 1.000 |
| Other hydrocarbons (mixed, non-halogenated) | | | | |
| Hydrocarbons $C_{10}$-$C_{40}$ | <20.000 | 35.100 | 347.000 | 300.000 |
| Other aromatic hydrocarbons (halogenated) | | | | |
| PCB | 0.076 | 0.132 | 0.436 | 0.200 |

## CONCLUSION

The facts presented above show that the material from the railway superstructure at the end of the life cycle has a huge potential for use as a substitute for natural resources of aggregates, if the right method of remediation of contaminated aggregate is chosen for subsequent use in construction practice.

The biggest advantages of reusing waste materials (in our case, aggregates from the railway superstructure) include:

- reduction of landfilling costs;
- protection of natural resources;
- reduction of emissions from transport;
- protection of the environment.


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