

Diffuse release of environmental hazards by railways

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Abstract

There is increasing concern about environmental pollution by diffuse emissions of various environmental hazards emitted by transportation activities. For the first time substances released by railways to the environment were investigated. We considered the significant sources and the amounts emitted by regular operation within the Swiss Federal Railways (SBB) network (7200 km tracks). The main substances are about 2270 t y⁻¹ metals, 1357 t y⁻¹ hydrocarbons and 3.9 t y⁻¹ herbicides. Most of the released metals are particles emitted by friction processes with iron, followed by copper, zinc, manganese, chromium, nickel, vanadium and lead. Only a small amount of metals is expected to be leached in dissolved phase. The emission of hydrocarbons may be diffusive (e.g. operational losses) or at point-sources (e.g. track-switch). The wooden sleepers seem to be the most important sources of hydrocarbons, followed by lubricants from track-switches and wheel flanges. The emissions reflect a spatial and temporal exposure pattern. The assessment is valuable for regulatory authorities working on soil and water protection as well as for railway companies determining their necessity of water and soil protection measures. Based on the results, selected studies may establish an understanding on relevant processes and environmental risk of railway imissions to soil, drainage water and groundwater.

Keywords: Railways; Environmental hazards; Diffuse emission; Water protection; Technical measures

1. Introduction

In the context of the European Water Framework Directive (WFD; 2000/60/EC), member

states are expected to establish pollution reduction programs including the control of diffuse emissions, discharge and measures. Several substances are mentioned in the directive as priority and specific pollutants (List I, II), e.g. copper, zinc, chromium, and polycyclic aromatic hydrocarbons

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(PAH). Protection of soil, surface water and groundwater requires knowledge on the impact of pollutants emitted, for example by the transport sector in a diffuse pattern. In fact, transport sector can be considered as an important source of diffuse pollution to the environment. Until now, numerous studies focus on road traffic pollution, but little is known about railways. However, regular railway operation is also associated with the diffuse release of inorganic and organic substances into the environment (Fig. 1) [1,2]. Some substances emitted by railway operation are listed in the WFD and there are strong indications that the environmental exposure has to be evaluated for several relevant pollutants. It has to be anticipated that substances entering railway ballast and soil may leach to groundwater or surface waters (Fig. 1) [3,4].

Knowing sources and pathways of the emissions, mass flow balances can be analyzed and technical and operational measures established. However, knowledge on emissions of regular railway operation and the fate and behavior of the substances in the track profile and environment are scarce compared to road traffic [5]. Thus, railway companies are not able to estimate the environmental fate of these emissions

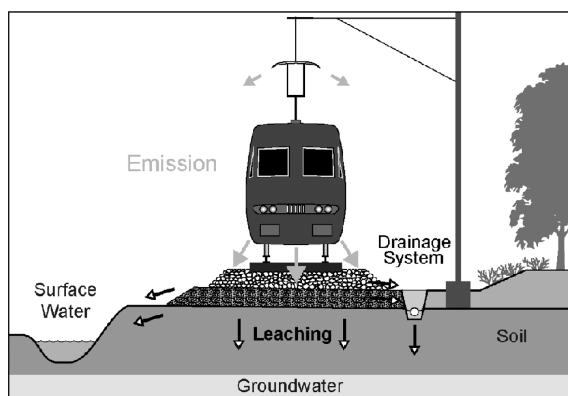


Fig. 1. Spatial distribution of substances emitted by regular railway operation and their pathways to groundwater and surface water.

or to assess if quality standards for water and soil protection are met (Fig. 2). Moreover, railway companies have problems to evaluate the efficiency of common drainage systems for substances mobilized from track profiles. Up to now, reduction measures like drainage systems along the tracks or infiltration of runoff are uncertain in terms of hazard retention efficiency (Fig. 2). With the lack of essential data on emission and fate, it becomes clear that an environmental impact assessment can presently not be fully established.

The aim of the study is an assessment of diffuse losses relevant for the environment. We investigated emission patterns from different sources released in the entire railway network of Swiss Federal Railways (SBB) (Fig. 2). The presented emissions focusing on the most relevant sources and substances were extracted (Fig. 2, gray box) from Burkhardt et al. [6]. To our knowledge it is the first assessment in which all substances emitted by railways are quantified.

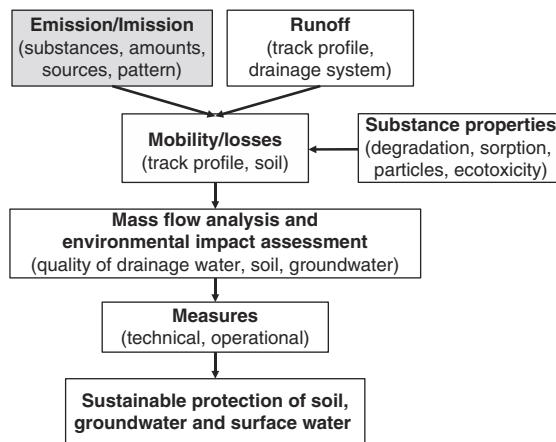


Fig. 2. Overview of the entire study “water protection along railway tracks” evaluating the environmental risk of construction materials and railway operation and maintenance. The part emission (gray box) is already complete and presented in this publication.

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