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Foam: a conflicting transboundary issue

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INTRODUCTION

The occurrence of foam downstream of weirs in a lowland river in Austria and short after the Austrian-Hungarian border led to massive protests from the Hungarian locals and stakeholder organisations. Finally public media could be mobilised in a way that the conflict between Austria and Hungary was pushed to a governmental level. On the one hand Hungary was blaming Austria for pollution this transboundary river, on the other hand in Austria no profound scientific analyses of cause-effect relationship for the foam formation was available. This led to investigations (i) to objectify the dimension of the appearing of foam, (ii) to evaluate the reasons for the foam formation, (iii) to develop abatement-measures and (iv) to suggest standards for legislative implementation of abatement measures.

Massive occurrence of foam on rivers was supposed to be eliminated after the introduction of biodegradable contents in detergents and the biological treatment of waste water in waste water treatment plants. Neither in Austria nor in European Union legal standards for foam formation on rivers existed so far (Anonymous, 2000, 2003) and pollution of rivers by foam is not a great subject of scientific discussion as well. Nevertheless formation of foam is still and becomes more and more a relevant topic for freshwater ecosystems. Its visibility makes it more obvious to the public than “hidden” chemical pollution and may create, in cases that it still appears, massive public concern, as it happened below the Hungarian/Austrian boarder. The presented investigation was the basis for development of a management plan for the abatement of foam formation and thus a significantly helped to find a solution for this transboundary con-

flict.

MATERIAL AND METHODS

A one year monitoring programme included a close network of surface water sampling sites, an online monitoring station (Winkler et al., 2007) as well as the sampling of effluents from thirteen municipal and industrial wastewater treatment plants along the river stretch. Next to classical physical and chemical parameters the surface tension as sum parameter for surface active compounds and selected surfactants were analyzed. The constant observation of the foam formation in Hungary was achieved by the installation of an online webcam and resulted in the development of a seven-stage foam index (0-6) based on the evaluated webcam pictures. The effluents of the considered wastewater treatment plants were subject of standardised foaming tests. Basis of the test was to detect (i) foam on the sample and (ii) the dilution of a sample at which no more foam could be observed. The dilution factor, at which minimal foam occurred, was called “foaming factor”. The obtained foaming factor of an effluent was multiplied with the effluents discharge to calculate the “foam potential”. Foam potential was defined as the volume of river water which can potentially get foamed by discharge of a particular effluent (Ruzicka et al., 2007).

Based on the observations a correlation model has been developed, which describes the relation between the foam potential emitted from the sum of all point discharges, the river water discharge and the “foam index” of foam formation at the weir in Hungary. This correlation model subsequently has been used to calculate the potential effect of foam potential emission reducing measures on the resulting foam index.

All relevant point dischargers in the catchment (municipal and industrial) already perform waste water treatment according to best available technique (mainly low loaded biological treatment with nitrification/denitrification and phosphorus removal). Additional treatment steps would have to be performed in order to improve discharge quality. To evaluate possibilities of advanced treatment laboratory experiments have been performed with the effluents of the most relevant dischargers using adoption, precipitation and advanced oxidation (Ozon) techniques (Wegricht et al., 2007). The main goal of these experiments was to find possibilities of improvement of foaming factor/foam potential, surface tension as well as COD in the waste water effluents. Finally one of the most relevant dischargers started corresponding pilot scale experiments for foam abatement using a combination of coagulation, flotation and adsorption with activated carbon.

RESULTS AND CONCLUSIONS

All of the analysed surfactants (e.g. LAS, QAC, NP, NSA) could not be identified as

reason for foam formation. Either they appear in concentrations too low to be responsible for the foam on the river (e.g. LAS) or they do not cause foam at all (e.g. NSA). Thus it was not possible to indicate one specific substance as reason for the problem with the foam. The appearance of foam seems to be a summation effect of different substances with surface active properties not belonging to already recognised substances of priority. Therefore sum parameters for surface active compounds had to be used. In this respect the obtained dilution factor and the surface tension of the samples showed good correlations to each other, which indicated the objectiveness of the developed method of foam tests. The correlation of these parameters to COD was only weak, showing that the total of organic compounds is only a weak indicator for the occurrence of surface active substances.

A multiple correlation between the total emission of "foam potential", river discharge and resulting foam index in the river at the weir has been found and resulted in the development of the already mentioned correlation model, which was the base for the evaluation of the effect of measures reducing foam potential emissions on foam index development (Ruzicka et al., 2007). The main contribution of emissions of foam potential to the river comes from three tannery effluents, which are characterised by a low surface tension as well (50 to 60 mN/m as compared to about 72 mN/m of clear river water). Therefore measures to reduce foam formation have to concentrate on these dischargers. All tanneries already have biological waste water treatment with a sludge age > 20 d at temperatures > 20 $^{\circ}$C. No additional improvements can be expected by additional biological treatment. Laboratory experiments indicated advanced oxidation with ozone as appropriate measure to significantly improve foaming factor/foam potential and surface tension of the tannery effluents (Wegricht et al. 2007). Related costs motivated one of the companies to start their own pilot plant for tertiary treatment with coagulation and flotation. Finally in combination with an additional step of adsorption with activated carbon the pilot plant succeeded in sufficient reduction of surface active compounds. Cost comparisons between these possible measures are still going on.

To be able to force the implementation of foam abatement measures at the tanneries the responsible authorities intend to release a tightened emission regulation for tanneries. Based on the results presented above the surface tension was chosen as parameter for setting new standards. Standards for tannery effluents of 60 mN/m for average and high flow conditions and 65 mN/m for low flow situation are expected to reduce the appearance of foam which is not accepted by Hungarians from a probability of approximately 40 % to less than 5 %.

1 References

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