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Social Acceptance and Efficiency of the Application of Masking Agents in Urban Areas

Valentina Lazarova*[a], Gabriela Markovska[b], Brahim Abed[c], Thierry Dezenclos[c] and Aït Amara[d]

[a]Suez Environnement - CIRSEE, 38 rue du Président Wilson, 78230 le Pecq, France
[b]University Paris V, 12 rue de l'Ecole de médecine, 75270 Paris, France

[c]SEAAL (Water and Sanitation Company of Algiers), 97 Parc Ben Omar, BP 249 Kouba, Algiers, Algeria
[d]Ministry of Water Resources, Algiers, Algeria*email of the corresponding author
*valentina.lazarova@suez-env.com

This paper presents and discusses the results of the project named "Jasmin" implemented in Algiers (Algeria) to control the strong odours of the river named Oued El Harrach, one of the largest rivers in the centre of the city, which is polluted with raw sewage and industrial effluents. Pending the achievement of curative solutions, a temporary option for mitigation nuisance odour by masking agents was implemented in the vicinity of the main bridges. The efficiency of this technology has been followed by means of an odour panel with the participation of representatives of all stakeholders. A sociologic study by means of 1000 questionnaires and face-to-face interviews of local populations demonstrated the benefits and the positive outcomes of the attenuation of odour nuisance: 70% of the population is satisfied or very satisfied with the application of masking agents and 96% of respondents support the continuation of the project. In terms of size and public access, the project "Jasmin" is a world first demonstration of odour control in urban areas in developing countries.

1. Introduction

In recent years, sensitivity and intolerance of large public to odour nuisance has significantly increased and new regulations were implemented in many developed countries (Frechen, 2000; Stuetz and Frechen 2001). An increasing concern for efficient odour control in urban areas is also observed all over the world, both on developed and developing countries. The social impacts of olfactory perceptions are becoming an issue and an increasing public concern (Remy and Estades, 2007) as the air quality can affect lifestyle and public attitudes.
In 2007, the government and local authorities of Algeria decided to implement a demonstration project for odour control of the Oued el Harrach in the centre of the capital city of Algiers for the mitigation of odour nuisance. The discharge of raw urban and industrial wastewater and the accumulation of sediment were the main cause of the emission of unpleasant odours, in particular during summer periods. A large investment program of sanitation and rehabilitation of the river was launched by the Algerian government and a temporary project for odour control by masking agents was implemented in the vicinity of the main bridges. In parallel, an odour panel was constituted with representatives from the local authorities, local population and the operator for the evaluation of the efficiency of masking

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agents. In 2009, a sociological survey was performed by the team of SEAAL with the support of Suez Environnement and the University Paris V.
The main objective of this paper is to present the results of the efficiency of the attenuation of odour nuisance by the selected masking agents and the public perception of this project.

2. Materials and Methods

Different types of masking agents have been tested before the selection of the appropriate products and application method. The 8 products tested on-site in Algiers were selected according to the results of previous research projects on the efficiency of 26 commercial products used as masking or neutralizing agents against odour emissions and investigated at bench-, pilot- and full-scale (Bruchet et al., 2009).
Two products were selected, one in liquid form (dosage 0,1-2,0% in water) and one in a gel form, both provided by the Westrand company. The both products are proprietary patented chemicals composed by a complex of plant extracts, essential and synthetic oils that are solubilised by a synergistic blend of nonionic surfactants
On the basis of a preliminary odour mapping of the area of odour nuisance, it was decided to apply the masking agents on the three bridges, two from which characterised by a high pedestrian traffic (Figure 1). For the bridges with high pedestrian traffic, and as a complementary measure on the highway bridge, a gel product was selected and applied, which has a very high persistence (over a week even after heavy rain).

Figure 1: Views of the main areas of application of masking agents on the highway bridge and on the main pedestrian bridge

Figure 3: Views of the technical booth with the high pressure spraying station and PLC control

The mitigation of odours on the bridge of the coastal highway was the major challenge for the project team, due to the large area to cover of over one ha. The chosen solution was a fully automated micro-spraying device driven by a weather station including the following equipment (Figure 2):

- Micro-spraying stainless steel pad with a length of 204 m and 150 spray nozzles,
- Equipment room with a softener, filters, dosing pump and high pressure station (70-100 bar),
- Weather station,
- PLC with computer station, remote monitoring and remote data acquisition and equipment control.

Active products were selected specifically for this application because of their efficacy, public health safety, lack of any toxicity to the wildlife and the environment and the pleasant smell of jasmine, which corresponds to the traditions and cultural preferences of the local population. In addition, the masking agent used for spraying has been approved by the French health authorities for use indoors.

Since the start-up of the project, an odour panel was formed with the participation of SEAAL employees and representatives of all stakeholders, including local authorities. The methodology of odour characterisation applied is a sensory assessment using an odour wheel (Decottignies et al., 2007; Suffet et al., 2009; Perez et al., 2010). The main mission of this panel was to regularly monitor on-site the magnitude of odours in the area of the Oued el Harrach and the efficiency masking agents.

In 2009, a survey of public perception was performed with the assistance of the University Paris Descartes according to the methodology described by Martin (2009). Selected representatives from the neighbouring population (residents, merchants, employees and passengers) and industry were interviewed. This study was presented in the form of a questionnaire, face to face, with 1,000 residents on the two major bridges, the Highway Bridge ant the Pedestrian Bridge “Maison Carrée”. It is important to stress that the study site and timing were selected according to specific methodological requirements regarding the odour occurrence and intensity, and the sample of the population interviewed. 70% of respondents are frequently using the selected study sites in the odour nuisance area. The processing of data obtained was performed using the statistical software MODALISA, used in France by several large companies such as statistical surveys of INSEE (National Institute of Statistics and Economic Studies) and the CNRS (National Centre of Scientific Research).

3. Results and Discussion

3.1 Evaluation of the efficiency of masking agents

The efficiency of the application of masking agents in the area of the main bridges of the river El Harrach was evaluated by the odour panel weekly during the summer period and once or twice by month during the periods with low odour nuisance.

The main descriptors of the odours of the Oued El Harrach, defined using the odour wheel described by Suffet et al. (2009) are shown on Figure 3. The strong odour nuisance potential is demonstrated by the presence of several descriptors which are typical for sewage and anaerobiosis, such as putrid, rotten eggs, as well as hydrocarbons and solvents typical for industrial wastewater discharge. Each of these descriptors is contributing to about 30% of the olfactory fingerprint with a strong presence of rotten eggs of 10%.

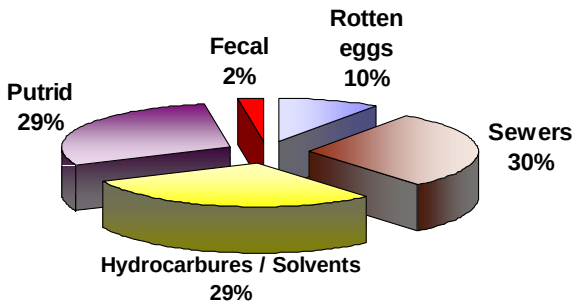
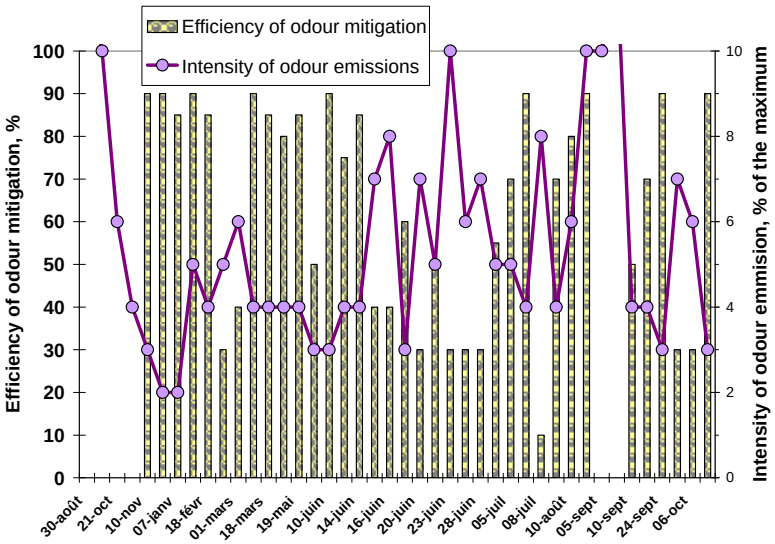


Figure 3: Olfactory fingerprint of the Oued El Harrach

The results of the odour panel observations for a 3-year period in the vicinity of the Highway Bridge are illustrated by Figure 4. The odour emission intensity of the river is displayed as % of the maximum intensity, evaluated on a scale of 0 to 12. The percentage of odour attenuation is calculated from the

odour observations in 8±2 points in the bridge' areas on the basis of the wind direction and the occurrence and intensity of both nuisance odour and the trace flavour of the masking agent.



A clear improvement of olfactory comfort was observed during normal operation of the spraying pad with up to 90% effectiveness of masking agent during winter periods when the intensity of the odour emission from the river is below 50% of the maximum value.

Figure 4: Evolution of the odour mitigation efficiency on the highway bridge as a function of nuisance odour intensity

During the periods of strong odours and in the presence of temporary failure of the spraying facility, odour mitigation temporarily drops to 10-30% with the only action of the jelly product on the North side of the bridge. Because of the high area of the highway bridge, about 2 ha (220 x 90 m), the efficiency of odour attenuation dropped to 10-30% when the spraying facility was switched off, mainly due to failures of power or water supply. The average annual efficiency of odour mitigation on the highway bridge was 76%, which is considered as satisfactory to maintain a good olfactory comfort for the residents and vehicle passengers.

Regular application of gel on the pedestrian bridges, especially on the most crowded Pedestrian Bridge "Maison Carrée", has given a very high satisfaction to residents and merchants. The efficiency of nuisance odours' mitigation has been systematically evaluated for more than 60% by the odour panel, with an average annual value of 88%. The development of an appropriate methodology for on-site application, well adapted to local conditions in terms of dosage and frequency, are the main factors to success.

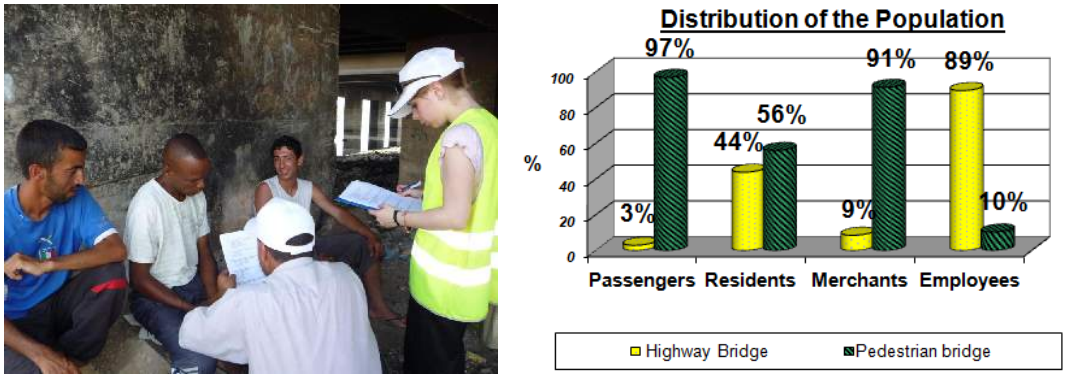
3.2 Quantifying public perception of odours: the sociological survey results

With the active collaboration of residents and stakeholders, a very good sampling of the population was obtained with 1000 questionnaires completed during face-to-face interviews (Figure (5a): 47% and 53% in the areas of the Highway Bridge and the main pedestrian bridge, respectively. Among participants, 57 % are men and 43% women, which is a good gender distribution. In addition, 70% of respondents are residents or employees crossing the bridges at least 2-3 times a day. Different social categories of the neighbouring population were included in the survey, e.g. representatives of the residents, merchants, employees and passersby on the two selected sites (Figure 5b).

The results of the survey demonstrated that 76% of the respondents believe that odours have a negative impact on their daily live and wellbeing. The perception of odour is slightly higher among women, 81% against 73% among male respondents (Figure 6a). The majority, 92% of people who recognized a negative impact of unpleasant odours believe that the extent of the nuisance is important or very important, and 65% consider it very important (Figure 6b). The magnitude of odour nuisances is considered slightly higher in the vicinity of the pedestrian bridge.

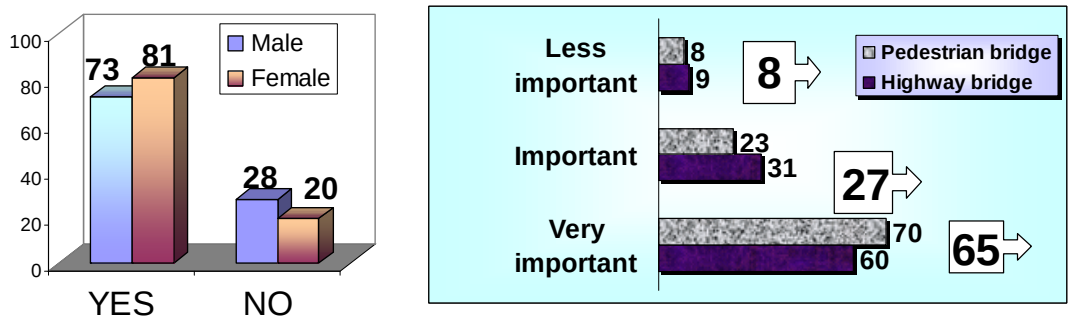
A more detailed analysis of olfactory annoyance among residents indicates that the strongest negative impact is felt in homes and especially during aeration. The magnitude of this impact is considered strong and very strong by 75% of respondents. With regard to the distance between the housing of

local residents and the river El Harrach, the people most affected are those who are living within 0.5 km of distance, 85% compared to 45% for housings situated from 0.5 to 1.0 km.



a) b)

Figure 5. View of the face-to-face interviews (a) and distribution of the surveyed population (b)



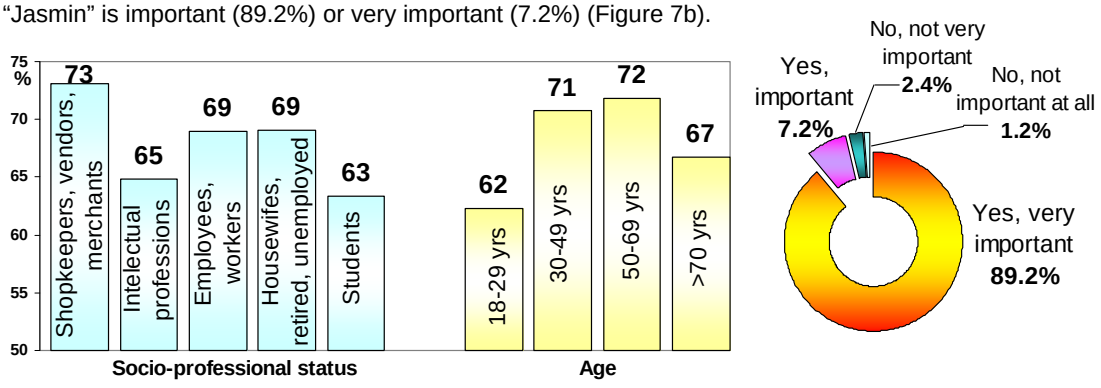
a) b)

Figure 6. Gender distribution of the surveyed population negatively affected by odour nuisance (a) and perception of the magnitude of the negative impact of odour nuisance depending on the location of the survey (b)

For the category of merchants (shopkeepers and vendors), it is interesting to note that the strong negative impact of odours is perceived in 49% of cases as an essentially economic impact, in terms of loss of clients and indirect economic damage. A more in-depth analysis shows that 76% of the shopkeepers whose stores are located between 100 m and 500 m away from the source of odour are considering that odour nuisance has a negative impact on their business against 34% whose shops are located farther than 500 m. Over 75% of restaurant managers recognize a high frequency of customer complaints because of unpleasant odours.

Although temporary and limited in terms of treated area, the efficiency of masking agents is very satisfactory for the majority of residents: 70% of respondents were satisfied or very satisfied. The gender distribution is 72% of women and 66% of men participating in the survey. The influence of socio-professional status and age of respondents is relatively low: the most satisfied local residents (71±2%) are shopkeepers and housewives in an age of 30 to 69 (Figure 7a). Students and young people (age of 18-29) seem the least satisfied from the odour mitigation actions (only 62%). It is important to stress however, that 69% of the shopkeepers and restaurant managers are recognizing a significant reduction in customer complaints and an economic rebound of activity after the implementation of masking agents. Similarly, 62% of the local residents most at risk report an attenuation or even disappearance of the odour nuisance. On the question “Is it important to continue

the odour mitigation actions?", 96.4% of residents are considering that the continuation of the project "Jasmin" is important (89.2%) or very important (7.2%) (Figure 7b).



a) b)

Figure 7. Influence of age and socio-professional status of respondents on their perceptions of the positive impact the project "Jasmin" (a) and importance to continue odour mitigation actions (b)

4. Conclusions

The application of masking agents in the vicinity of the main bridges of the river El Harrach in Algiers, characterised by strong odour nuisance during the periods of low flows and high temperature, demonstrated a relatively high efficiency of odour mitigation. The effectiveness of odour attenuation, evaluated by an odour panel, was in average 76% on the highway bridge where a spraying technique is used. The average efficiency of the jelly masking agent on the pedestrian bridge was 88%. Almost total, up to 90% neutralisation of odour nuisance was achieved at optimal weather and operating conditions.

The sociological survey performed during the most critical period of June-July demonstrated that, in general satisfaction, the strong odour nuisance in the centre of Algiers has been successfully mitigated by the application of masking agents. The sociological survey showed that 70% of the 1000 residents, shopkeepers and employees surveyed were satisfied with the temporary improvement in the olfactory comfort. 96.4% of the population considers that it's important and very important to continue this project until the rehabilitation of the river bed and the treatment of raw urban and industrial sewage.

Reference

Bruchet A., Decottignies V., Filippi G., 2009, Effectiveness of masking agents: outcome of a three-year study at pilot and full scales. Water Science & Technology. 60(1), 97-105.

Decottignies V., G. Filippi, A. Bruchet, 2007, Characterisation of odour masking agents often used in the solid waste industry for odour abatement. Water Science & Technology. 55(5) 359–364.

Frechen F.B., 2000, Odour measurement and odour policy in Germany. Water Science and Technology. 41(6) 17–24.

Martin O., 2009, L'analyse de données quantitatives- L'enquête et ses methods. Paris, Armand Collin, coll. « 128 ».

Perez A., Cortina JL., Palacios A., Gu1lon M., Lazarova V., Bouchy L., 2010, Assessment of the odour footprint of an underground WWTP in Barcelona (Spain). Chem. Eng. Transactions, vol. 23, 201-206.

Stuetz R., Frechen F.B., eds., 2001, Odours in wastewater treatment: measurement, modelling and control. IWA Publishing, London, UK.

Suffet I. H. (Mel), Decottignies V., Senante E., Bruchet A., 2009, Sensory Assessment and Characterization of Odor Nuisance Emissions during the Composting of Wastewater Biosolids. Water Environment Research. 81(7), 670-679.