Treatment of air pollution from industrial emissions with innovative technology integrated into a network of AHUs:

The Targu-Mures case in Romania

Paolo BRUNO – 25/09/2013

Introduction

AIR SÛR is an SME specialized in the engineering and implementation of innovative air purification solutions.

AIR SÛR brought its expertise to **BNP Paribas Real Estate** in Targu-Mures (Romania) for the management of an air pollution issue affecting economic activity.

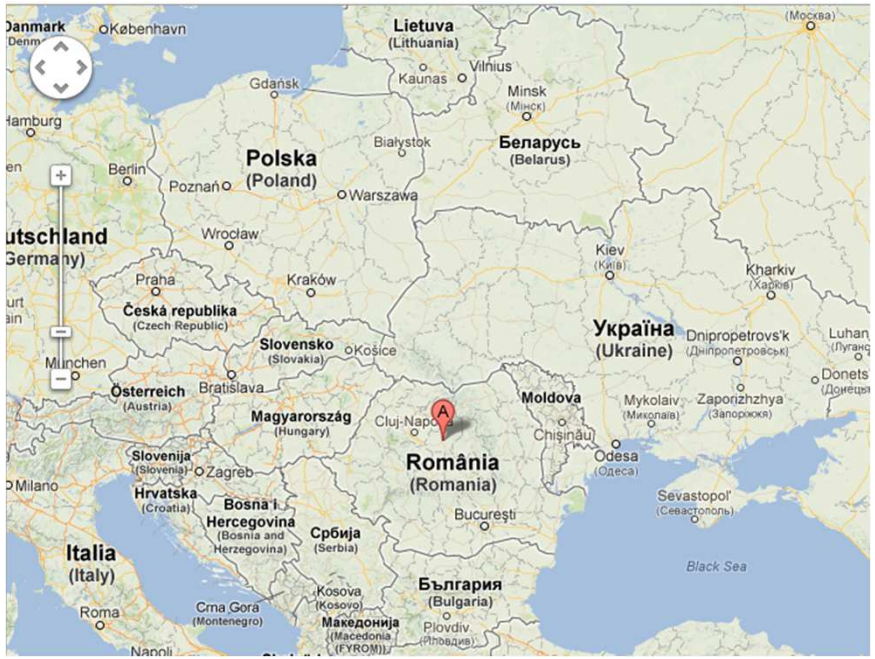
<u>Target of the project</u>: implementing ammonia purification modules on the existing Air Handling Units of a shopping mall and cinema multiplex affected by gaze's emissions coming from a nearby fertilizer chemical plant.

Târgu-Mures situation

Târgu-Mureș *is the seat of Mureș County in the north-central part of Romania. As of 2011 the city had a population of 127,849 inhabitants, being the 16th largest city in Romania.*

Târgu-Mureș *is an industrial site with over 8500 companies. Main industrial sectors are:*

- *Chemical industry (**Azomureş**)*
- *Food industry:*
  - ✓ *Bread industry (Mopan)*
  - ✓ *Dairy industry*
- *Wood industry*
- *Textile industry*
- *Leather industry*



Azomures Plant

The Nitrogenous Fertilizer Plant Tîrgu-Mureş – known today as AZOMUREŞ *– was founded in 1962 as a producer of nitrogenous fertilizers. The Nitrogenous Fertilizer Plant Tîrgu-Mureş consisted of three main producing plants (**ammonia**, **nitric acid** and **ammonium nitrate**) and five auxiliary units necessary for providing the plant with cooling water, demineralized water, steam, electric power, spare parts and equipment. After 1990, AZOMURES had gone through several periods of restructuring, a privatization in the late 90's, and in 2012 the property was transferred to the **Ameropa** company.*

The **Azomures** emissions are affecting the nearby activity area

Issue: treatment of ammonia gas odors affecting the Cinema Complex located nearby the chemical fertilizer plant

Imput Data of Air Handling Units

The Air Handling Units (AHUs) of the Shopping Mall - Cinema Complex are interested by the release of ammonia coming from the nearby plant.
The particulate filtration system of each AHU consists of a series of F5 and F7 filters, which generate a pressure drop of 300 Pa for each line.

Line	Nominal flow rate (m^3/h)
AHU n°1	16 850
AHU n°2	9 350
AHU n°3	7 150
AHU n°4	5 500
AHU n°5	6 250
AHU n°6	7 500
AHU n°7	7 000
AHU n°8	14 100
AHU n°9	20 000
AHU n°10	8 160

Choice of technology

What are the possible treatment technologies for this type of ammonia release?

- **Adsorption on activated carbon**
- **Combination of catalytic technologies (Airficiency©)**

Choice of technology

Advantages and disadvantages of possible treatment technologies

- **Adsorption on activated carbon**
  - Research for a specific medium with high affinity for ammonia
  - Proven efficiency
  - Generation of high pressure losses on the AHUs (increased consumption of turbines)
  - Possibility of ammonia releasing once the media is saturated
  - High maintenance costs
- **Combination of catalytic technologies (Airficiency©)**
  - Empirical determination of the number of light sources and media surface
  - Efficiency to be proven
  - Low pressure drops and negligible consumption of lamps.
  - No saturation of the support thanks to ammonia destruction
  - Low maintenance costs

Our Technology: Airficiency©

- Patent n° 2959672 -
- High Efficiency UV-C Photocatalysis Core -

- ✓ Photocatalysis is a process of oxidation and reduction reactions at room temperature involving a catalyst activated by a UV radiation.
- ✓ The gases are routed through a particulate filter to the photocatalytic reactor consisting of a catalyst support and a light source.
- ✓ The surface of the catalyst, loaded with titanium dioxide (TiO_2), is activated under the irradiation of UV-C and form hydroxyl radicals ($^{\cdot}OH$) by the photolysis of water molecules adsorbed on the active sites.
- ✓ The degradation process consists of a series of these oxidations initiated by hydroxyl radicals, strong oxidants.

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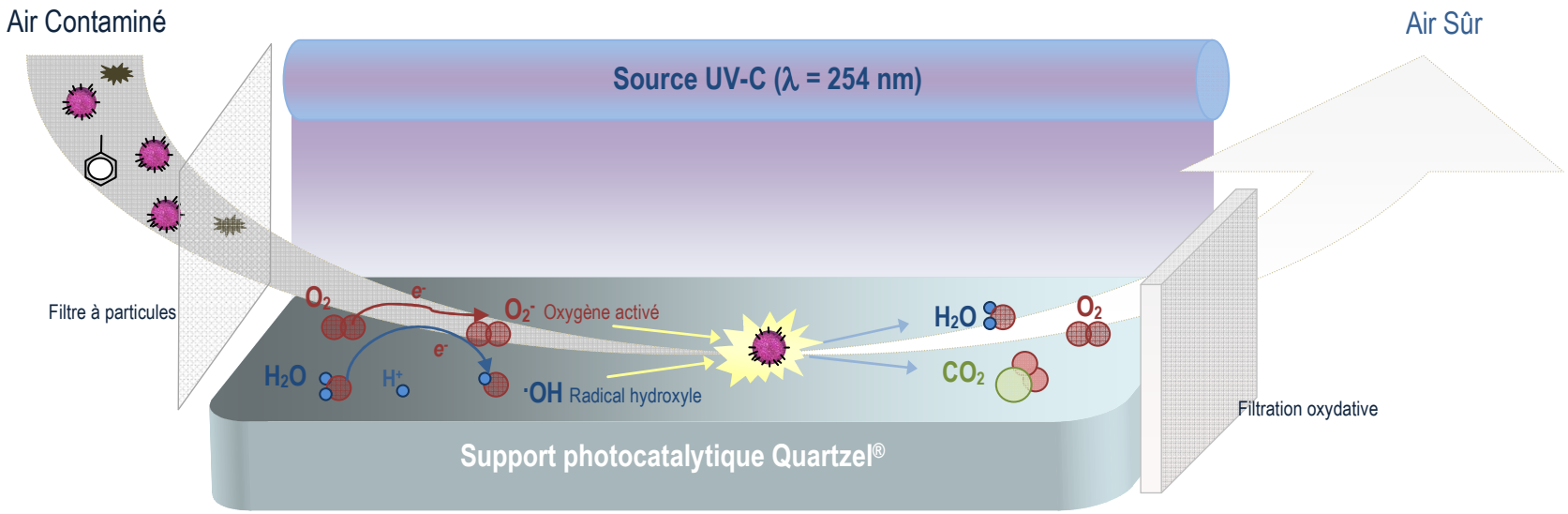


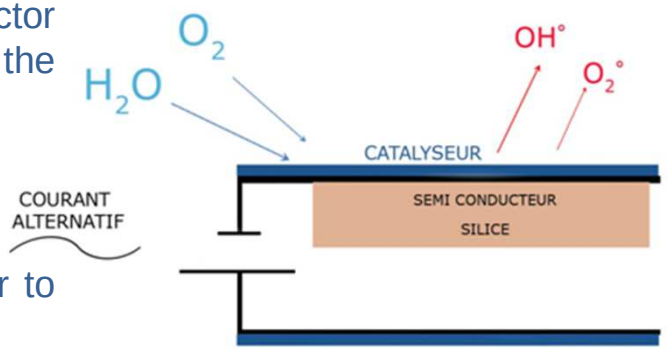
Coupling Photocatalysis with dielectric catalyst electrodes

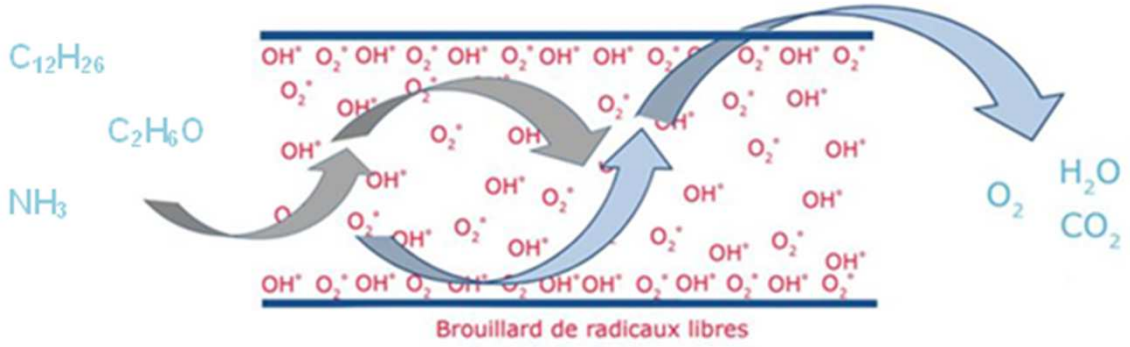
Generating a fog atmosphere of free radicals

Purification technology is based on oxidation and reduction reactions in ambient temperature involving a semiconductor catalyst activated by UV-C. Electrodes are placed within the photocatalytic reactor alongside UV-C lamps.

The semiconductor material (TiO_2) is fixed:

- On the media within the photocatalytic treatment chamber to activate the standard photocatalysis process;
- On the outer surface of the discharge electrodes to generate free radicals that are accelerated outwardly by the electric discharges.





Ammonia degradation

Ammonia (NH_3) is a colorless gas with a characteristic pungent smell. One of its main sources in the air is represented by factory farms.

Schematically radical decomposition of ammonia by photocatalysis is leading to nitrogen and water, as following:

$$2\,NH_3 + 6\,{}^{\bullet}OH \xrightarrow[TiO_2]{h\nu} N_2 + 6\,H_2O$$

The conversion rate or χ (percentage removal) of a compound A describes the maximum gradient of a species. It is expressed using the following equation:

$$\chi = \frac{C_{A\ initial} - C_{A\ final}}{C_{A\ initial}} \cdot 100$$

Where $C_{Ainitial}$ and C_{Afinal} are respectively initial and final concentrations of compound A before and after photocatalysis.

Ammonia degradation

The conversion rate indicates the effectiveness of specific systems towards specific compounds. It is then possible to evaluate the reactivity of NH_3 during photocatalysis. This reactivity and the associated conversion rate are depending on:

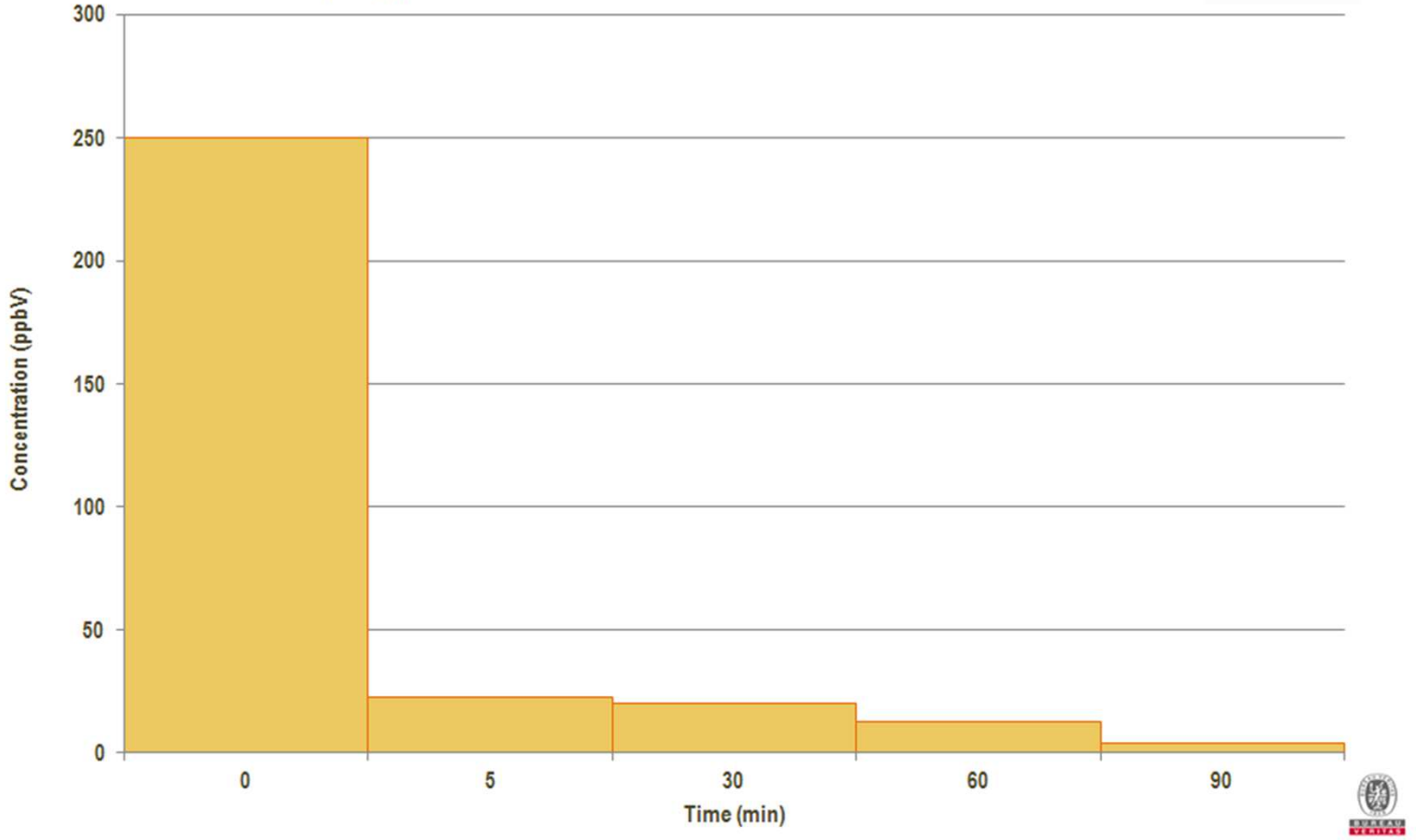
- The nature and intensity of light irradiation
- The number of incident photons permitting activation of catalyst
- The nature of the reaction medium, or its ability to absorb pollutants and the amount of active semi-conductor per unit area
- The water vapor content of the fluid to be treated for the production of hydroxyl radicals
- The nature and concentrations of pollutants of concern.
- The speed of the fluid on the reactor.

In some cases, there may be a deactivation of active sites of the catalyst support by adsorption of particulates on its surface. This deactivation is avoided by an upstream particulate filtration regularly maintained.

Knowledge and mastery of all the above parameters are an important added value of AIR SÛR.

Laboratory tests

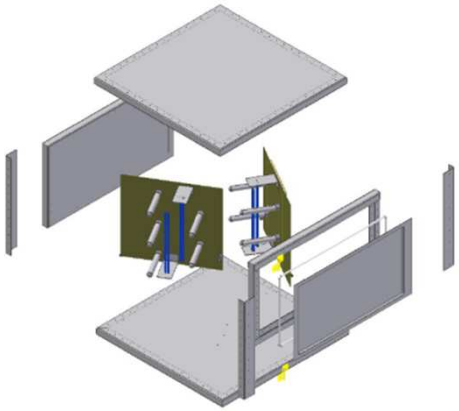
NH_3



Technology Implementation on Air Handling Units

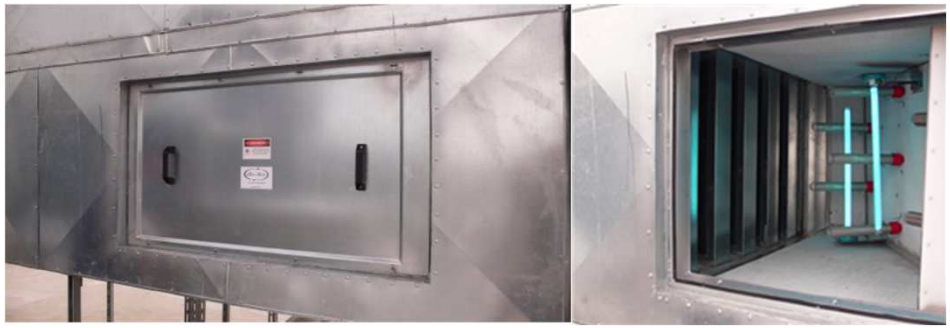
Phases of the Project:

1. Field Expertise and Realization Study
2. Manufacture of custom purification modules
3. Implementation on site
4. Test measurements validation by independent laboratory



Technology Implementation in Air Handling Units

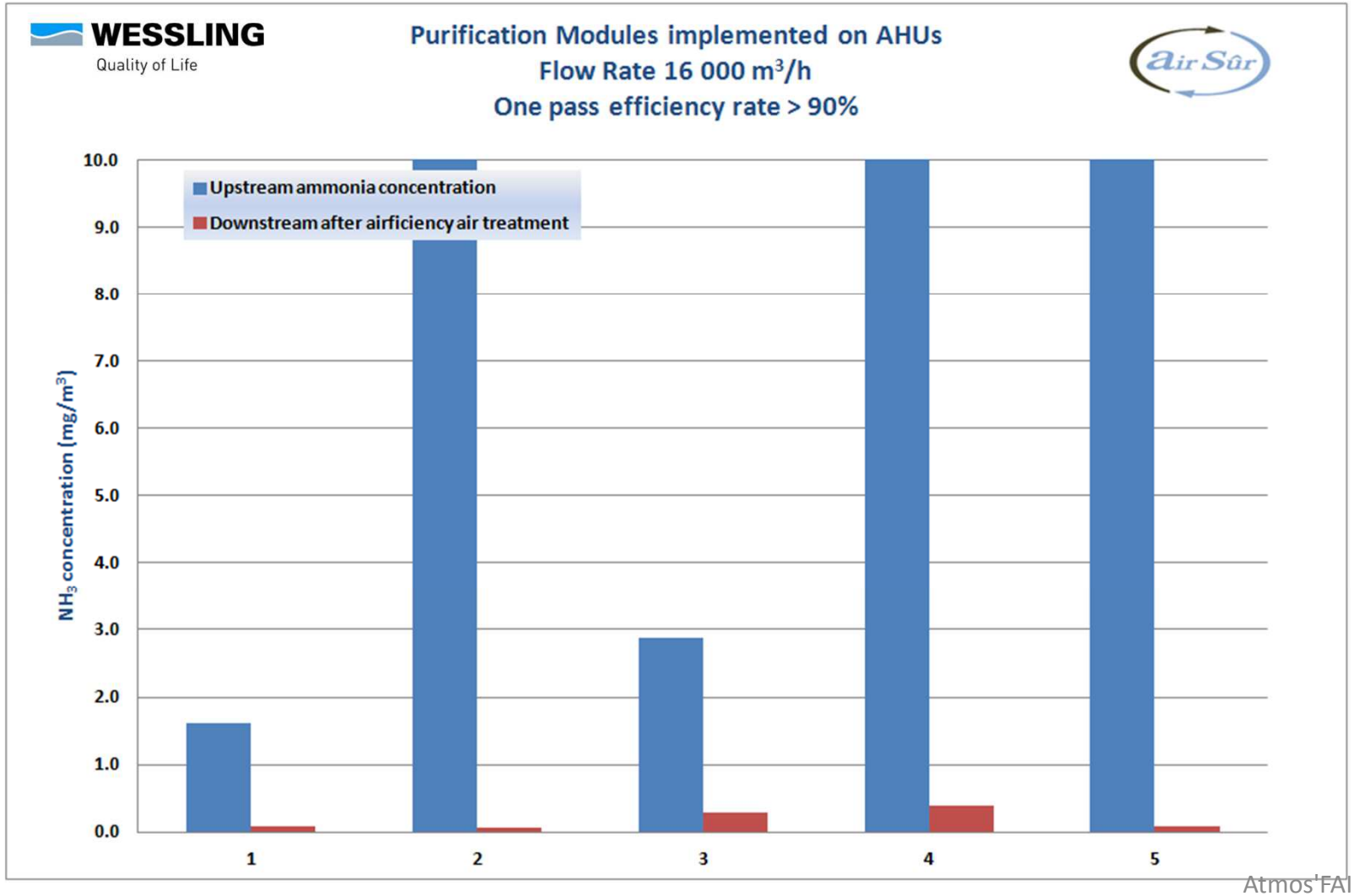
Our solution: **Integration of purification modules in the Air Handling Units of the cinema complex**



CINEMA CITY

BNP PARIBAS REAL ESTATE

Test measurements validation by independent laboratory



Airficiency© Benefits

- Light and flexible technology.
- Proven efficiency on VOCs, NH_3, NO_x, O_3 and other chemical pollutants.
- Low investment costs.
- Reduced maintenance.
- Low operating costs.
- Low power consumption.
- Used in finishing and/or pretreatment technology coupled with a standard treatment

Conclusion

An **industrial pollution issue** affecting a real estate activity park was solved applying air treatment expertise and implementing a new technology on existing Air Handling Units. The advantages of the applied **Airficiency©** technology compared with the standard solution of absorbing ammonia on activated carbon media are:

- **Higher conversion rates.**
- **Lower implementation and maintenance costs.**
- **Low energy consumption and low pressure drops.**

Thank You

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