USE OF MULTISTAGE HYBRID TECHNOLOGY FOR THE TREATMENT OF EMISSIONS THAT PRESENT CRITICAL ISSUES IN TERMS OF VARIATIONS OF THE CONTAINED MIXTURES AND VOLATILITY.

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1988 **Labiotest** is established: this company was borned as chemical laboratory for waste analysis, and through the years specialized in multipe solutions regarding air treatment and the abatement of odors, as well as that of chemical contaminants and dust.

Osmogenic barrier

DK Fil ®

Wet scrubber

Multistadium and hybrid system

Biological and chemical treatment

Dust abatement

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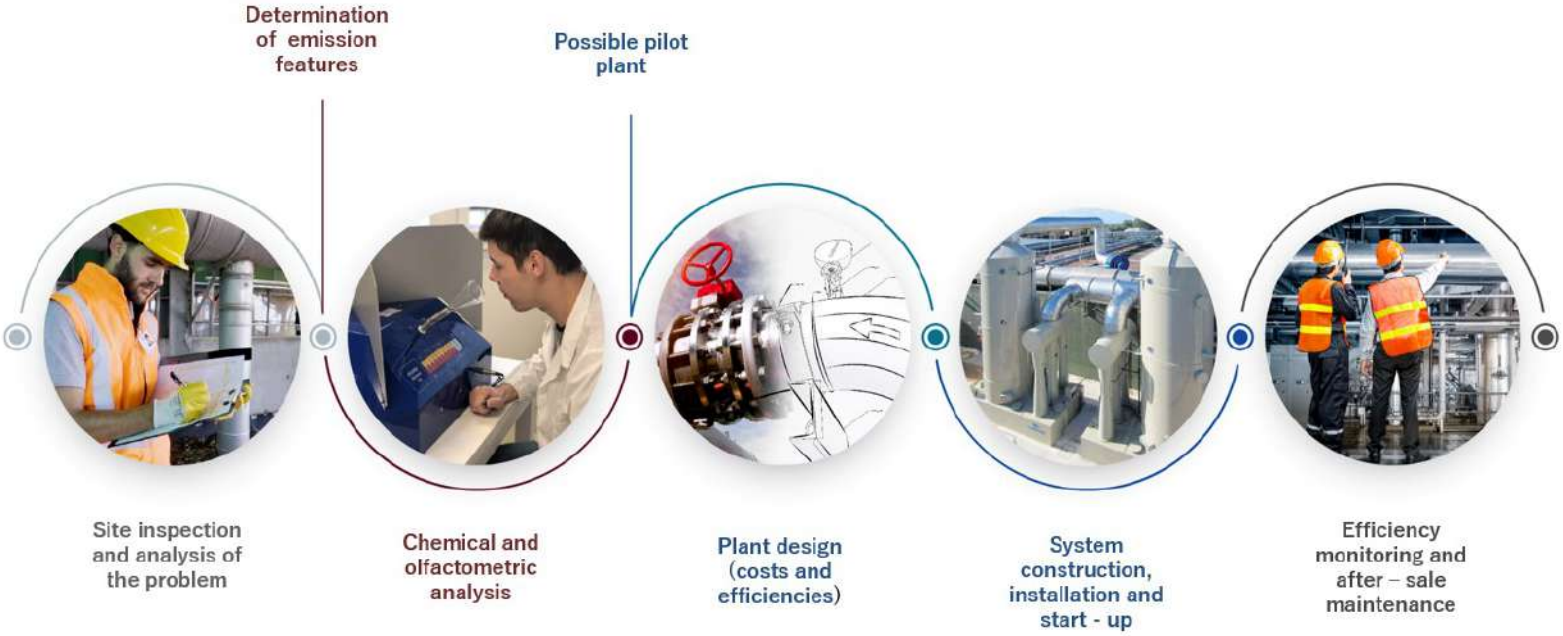
Many activities may present **“critical” production phases** in relation to the emission of odorous compounds.

The **increased sensitivity of the populations** to environmental issues, often the cause of social acceptability problems of some categories of plants, has led the legislator to lay the regulatory bases for a more rational policy, for the **regulation of “odorous” activities** also through the establishment of **rigorous air quality indices**, as well as **precise methods of measurement and evaluation of odors.**

Approach to air treatment solution



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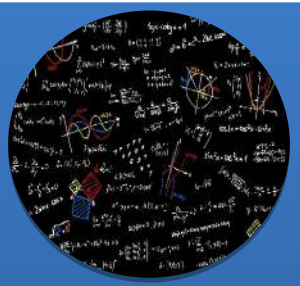
Data acquisition

Target: collect all information available

Production processes

Layout

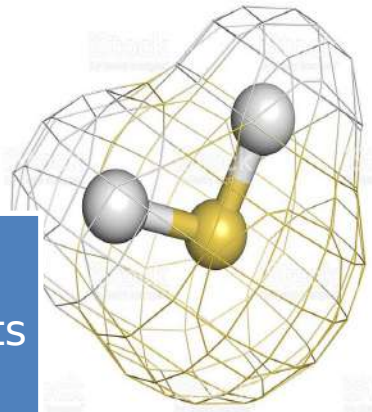
Authorization



Technical report

Design aspects

Which actions need to be taken?



Pollutants

Odour

Design aspects

Where is it necessary to act

Diffused emission

Convey ed emissio n

Site inspection and preliminary analysis

Existing collecting pipe

Existing abatement system

Standard working plant condition

Emission characterization and identification of target molecula on which address the treatment

Evaluation of preliminary data

Olfactometric and chemical survey

Test with pilot system and analytical sperimetal protocol

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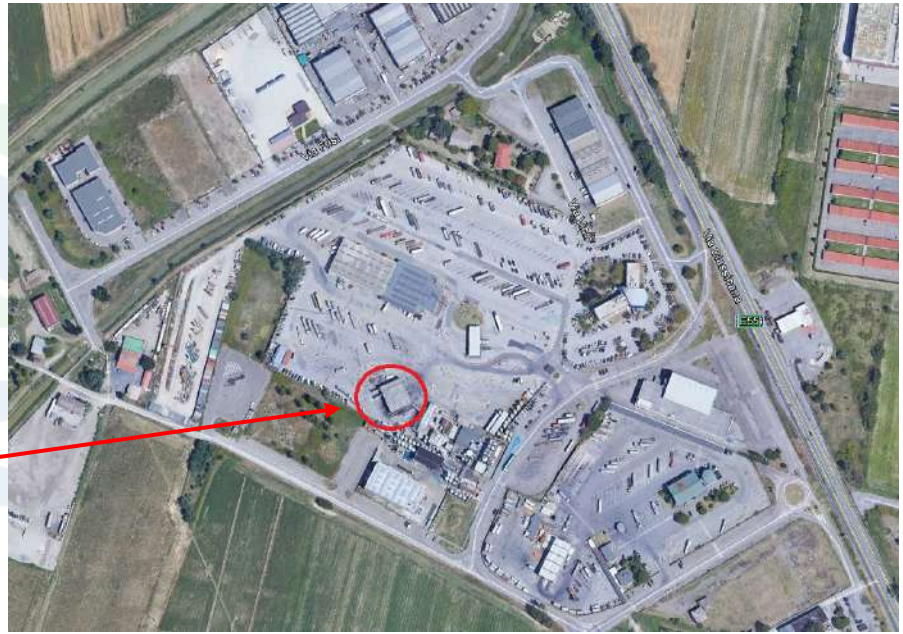
Case history: Tank truck washing

The plant under study deals with tank truck washing located in central Italy.

This report describes the whole process, starting from the study of emissions and all the way to the treatment and management during the washing process of tanks in order to identify a proper air and odor treatment technology, maintain the value of SOV and odour under prescribed limits, reduce the environmental impact of a production facility on its territory.

The area is indicated in the red circle in the photo.



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The first step necessary to approach the problem was to identify the emissive context as accurately as possible.





Complexity of emission

The plant works 6 days a week and washes tank trucks that transport over 400 various types of wastewaters containing more than 200 chemical components, variable in terms of volatile organic compound and odor, in presence of variable chemical compounds.

In particular SOV(as mg/m3) and odour OUe/m3) presented average values respectively of and 5000 (measured in a week of washing activity) creating a problem of not compliance with limits prescribed.

Complexity of emission

The washing of tanks containing chemical products takes place inside a dedicated track under a shelter where operators carry out the following operations to date:

- opening upper hatches;
- insertion of water jet washing heads;
- lowering of hatches;
- start of washing sequence.

Labiotest uses a strategy based on an **integrated approach**, between industrial process and reduction solutions.

It is necessary to understand thoroughly processes that generate the problem and which are fixed factors, and variable ones subject to possible modifications in order to mitigate the impact.

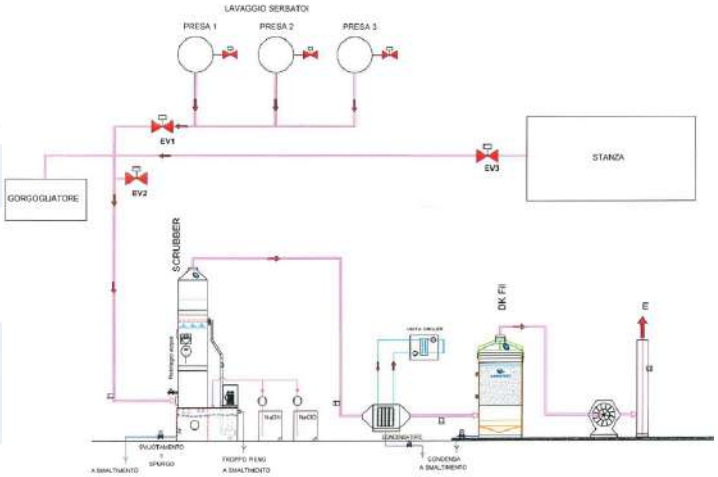
- Following the verification of the washing frequency of the different liquids contained in the tanks, it was decided to **provide an optimized system for the abatement of organic and acid compounds**.
- During spot washing of tanks **containing basic liquids, the performance of the system was not optimal** even if a substantial abatement of the emission compounds will still be carried out.

Hybrid system dimensioning

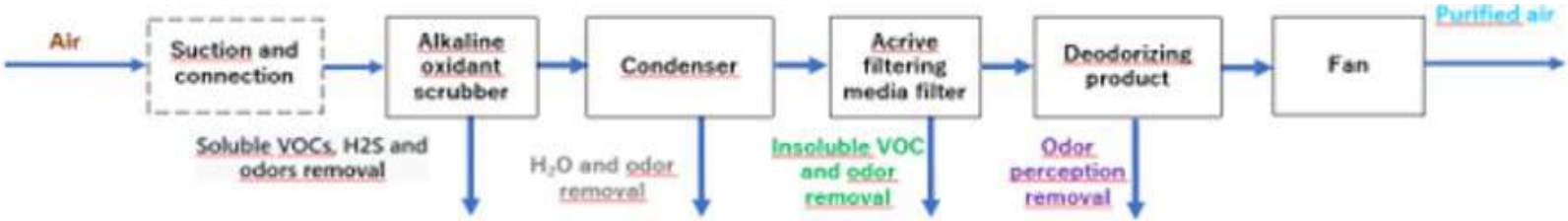
The designed hybrid equipment had to be able to manage the air exhausted from tank trucks during the washing operations, as well as the air in the hall housing washing waters booster pumps, as well as that of the air lock reservoir. Total flow rate was calculated as being of 1.000 m³/h.

The first step is to extract elements from the tank trucks, it was decided to use special conical washing taps that were to be introduced into the tank trucks openings. These taps allow for the confinement of

The whole extraction equipment was programmed through an automatic system, in order to allow for washing only when the suction system is activated.



Treatment steps



The extracted air follows different steps of abatement treatment

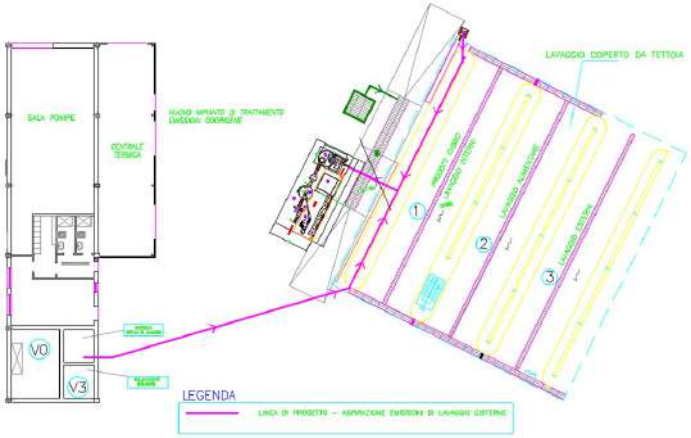
Differentiated collection according to the washing status;
Oxidizing alkaline wet scrubber (H2S salification with excess NaOH);
Condenser to avoid water entrainment, preserve filter media and condense low-boiling products;
DKFil® - Filter with 2 active masses: activated carbon, and Al2O3 pre-impregnated with KMnO4 (adsorption and oxidation);
Zephiro UTS ® - Nebulization of deodorizing product (physical action with osmogenic barrier);
Suction fan to avoid fugitive emissions;

Air intake

Each duct has a maximum suction rate of 80 m³/h approximately for each tank opening, for a total rate of 400 m³/h.
The abatement system also treats:

The air contained in the washing water recovery hall having a volume of 47 m³. (6 air exchanges per hour, for a total of 300 m³/h approx);
The air inside the air lock (at least 1 exchange per hour of the volume above liquid level of the water or equal to the flow rate of introduced water / steam).

Flow rate normally sucked in during plant operation is of 700 m³/h, and a valve allows for the suction of environmental air to compensate for the lack of air flow from the washing area.
The suction equipment for the washing area is operated only when washing operations are performed on tank trucks containing products that have a definite odor impact or when the staff in charge, after having evaluated the specific situation, feels this is necessary, in compliance with the foreseen procedure.



Washing truck tank system details






Hybrid system 1000 m³/h

SCRUBBER

DEMISTER
(condenser)

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Monitoring program

Following the installation of the equipment, a monitoring program was edited in such a way as to allow for the definition and survey of parameters possibly optimizing management procedures and maintenance intervals, **in order to guarantee the value of SOV and odour as established and authorized by control authorities**, as well as **instructions regarding ordinary and extraordinary maintenance in order to allow for abatement efficiency and evaluation of results over time, during the first year of operation.**

Surveys are performed to evaluate volatile organic substances in compliance with the **UNI EN 12619:2013 method**, and odors as of **UNI EN 13725/2004**, on a monthly basis, in order to evaluate output rates.

Volatile organic substances are measured at downstream of abatement system; odor sampling were taken at washing point (P1), at downstream of the scrubber (P2), at downstream of demister (P3) and downstream of DK FIL (P4).

Forms for monitoring activity

SCHEDA RILEVAMENTO DATI "IMPIANTO IBRIDO MULTISTADIO"

SCHEDA CONTROLLO GIORNALIERO

Mese		Lista Controlli	OK	NOK	Note	Operatore	Firma
Giorno	Ora						
1		LIVELLO REAGENTI: Ipoclorito; Soda					
2							
3							
4							
5							
6							
7		SCRUBBER: Pompa ricircolo; Range ph 9-11					
8							
9							
10							
11							
12							
13		CHILLER: Temperatura <5°C					
14							
15							
16							
17							
18							
19		DKFIL: Pressione Differenziale					
20							
21							
22							
23							
24							
25							
26		ZEPHIRO UTS: livello prodotto					
27							
28							
29							
30							
31							

SCHEDA CONTROLLO MENSILE

Mese		Lista Controlli	OK	NOK	Note	Operatore	Firma
Giorno	Ora						
		Controllo pH con cartina tornasole;					
		Svuotamento soluzione di lavaggio presente nello scrubber.					
		Pulizia dei pannelli filtranti del refrigeratore					

SCHEDA MANUTENZIONI STRAORDINARIE "IMPIANTO IBRIDO MULTISTADIO"

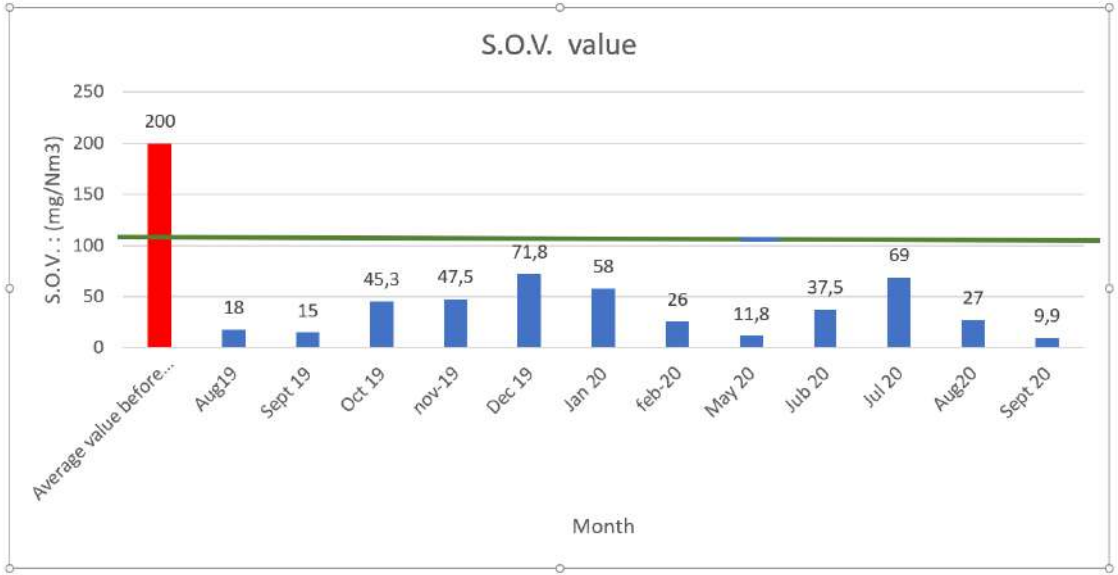
SCHEDA CONTROLLO QUADRIMESTRALE

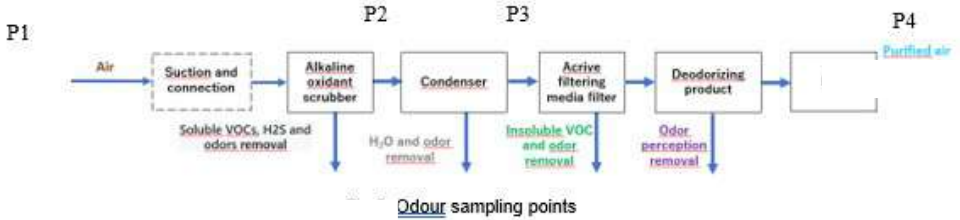
Mese		Lista Controlli	OK	NOK	Note	Operatore	Firma
Giorno	Ora						
1		Verifica funzionamento degli ugelli spruzzatori					
2							
3							
4		Verifica dello [illegible] delle vasche e rimozione di eventuali fanghi di processo da [illegible]					
5							
6							
7		Verifica pulizia coclea ventilatore					
8							
9							
10		Verifica assorbimento componenti elettromeccaniche					
11							
12							
13		Verifica pompa di ricircolo scrubber					
14							
15							
16		Verifica integrità tubazioni di dosaggio delle soluzioni reagenti					
17							
18							
19		Verifica impostazioni di set-up delle pompe dosimetriche e degli allarmi					
20							
21							
22		Taratura della sonda pH con soluzione tampone di riferimento					
23							
24							
25		Verifica e pulizia pannelli filtranti dell'unità refrigerante					
26							
27							
28		Analisi olfattometrica					
29							
30							
31							

Note aggiuntive

RESULTS OBTAINED

The monitoring survey program supported by ordinary activities and extraordinary operations entrusted to reduce the values of SOV and odour under acceptable values. We demonstrate that the hybrid technology is able to reduce chemical components and odor during washing operation





Sampling poit	Value OU_E/m^3 (average values)	Efficiency %
Upstream no washing activity	75	
Downstream no washing activity	70	
Operator station during washing activity (P1)	5.000	Value to be considered as white
Washing activity on-downstream scrubber(P2)	1.200	76%
Washing activity on-downstream demister(P3)	560	88%
Washing activity on - downstream DK FIL (P4)	150	97%

As far as **odor concentration**, without any washing activity upstream and downstream, there are values of 75 and 70 OU_E/m^3, an average value of **5000 OU_E/m^3** during washing activity has been measured.

The other three values have been taken downstream of each stage of treatment.

The reduction of pollutants has reached as consequecence also a reducing in odor emissions, the variability of values are due to the fact that there are components that generate odors when in low quantity and no longer generate them at higher r[illegible]

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Conclusions

The accurate study of the production process and its interaction with possible changes, useful to reduce the quantities of emissions that might cause a nuisance, together with an experimental type of approach beforehand, and **then a synergic effect through the use of several abatement technologies, at reasonable costs, demonstrated to be the best available solution to reduce the impact of a production facility on its territory, in terms of volatile organic compound and odor, in presence of variable chemical compounds.**

The installation of hybrid equipment demonstrated to be the most efficient one, as it allowed obtaining significant abatement rates, chemical as well as olfactometric, at reasonable costs, ensured throughout time.

The aim of the works has been reached with the significative reduction of volatile organic compounds and odour concentration as well as editing of a monitoring program and the further efficient activities as regards ordinary and extraordinary maintenance, permitted the equipment to operate constantly without creating problems for possible non-compliance with limits prescribed by Authorization DET-AMB-2019-552 or nuisance problems for the population living in the area.

General efficiency reached with hybrid plant in other applications

Field	Eff. COT [%]	Eff H_2S [%]	Eff odour [%]
Solid Waste	> 70 (3,3 – 1,0)	> 99 (500 – 0,0)	> 99 (3.600.000 -200)
Leachate	> 80 (3.856 – 766)	> 96 (100 – 3,5)	> 97 (160.000 – 4.400)
Petrolchemical	> 77 (2.576 – 573)	> 98 (193 – 3,0)	> 99 (40.000 – 365)

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