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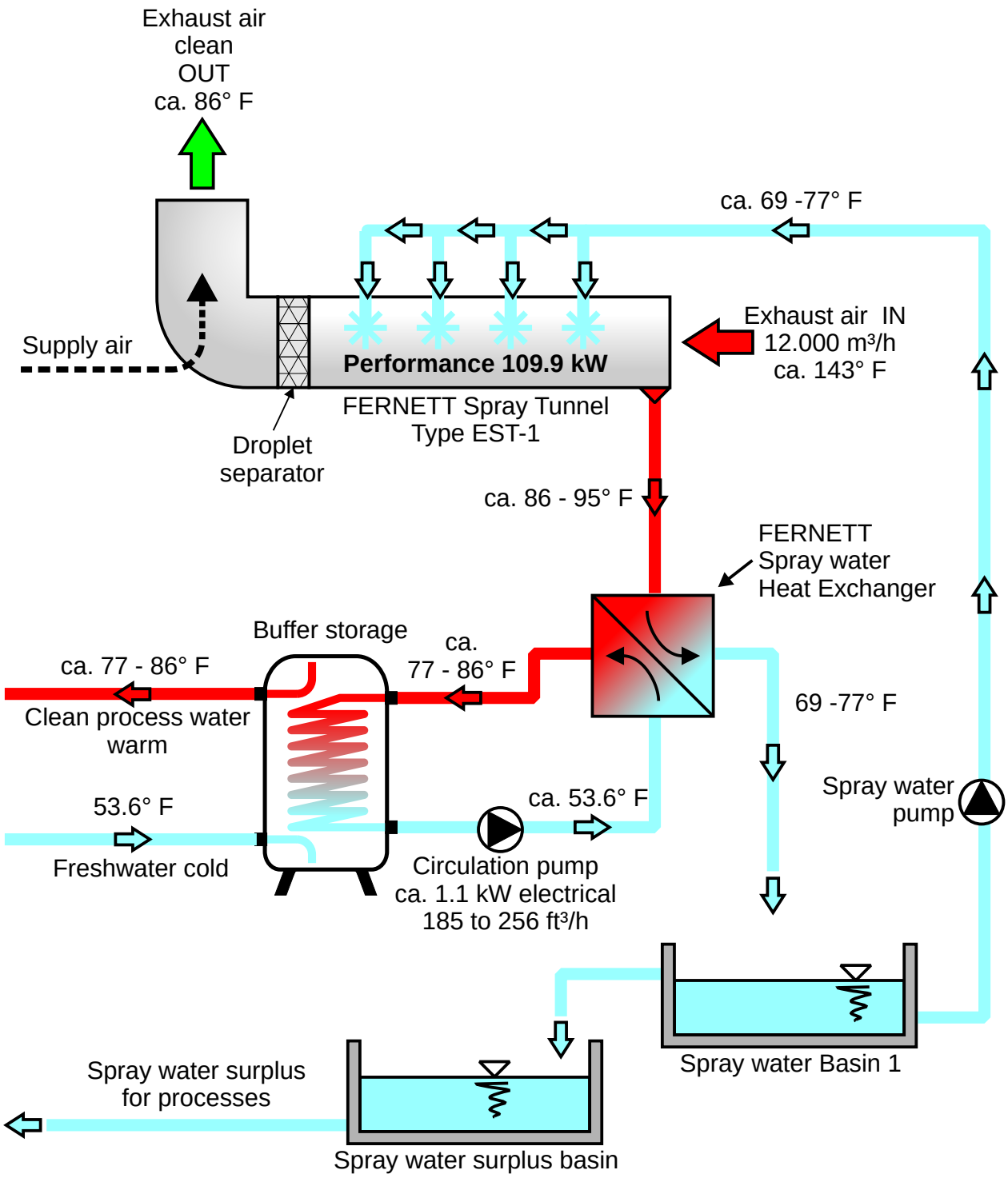
Case Study

Exhaust Air Purification and Exhaust Air Recovery in an industrial cardboard factory

CONTENT

SCHEMATIC
EXHAUST AIR PURIFICATION AND EXHAUST AIR HEAT RECOVERY



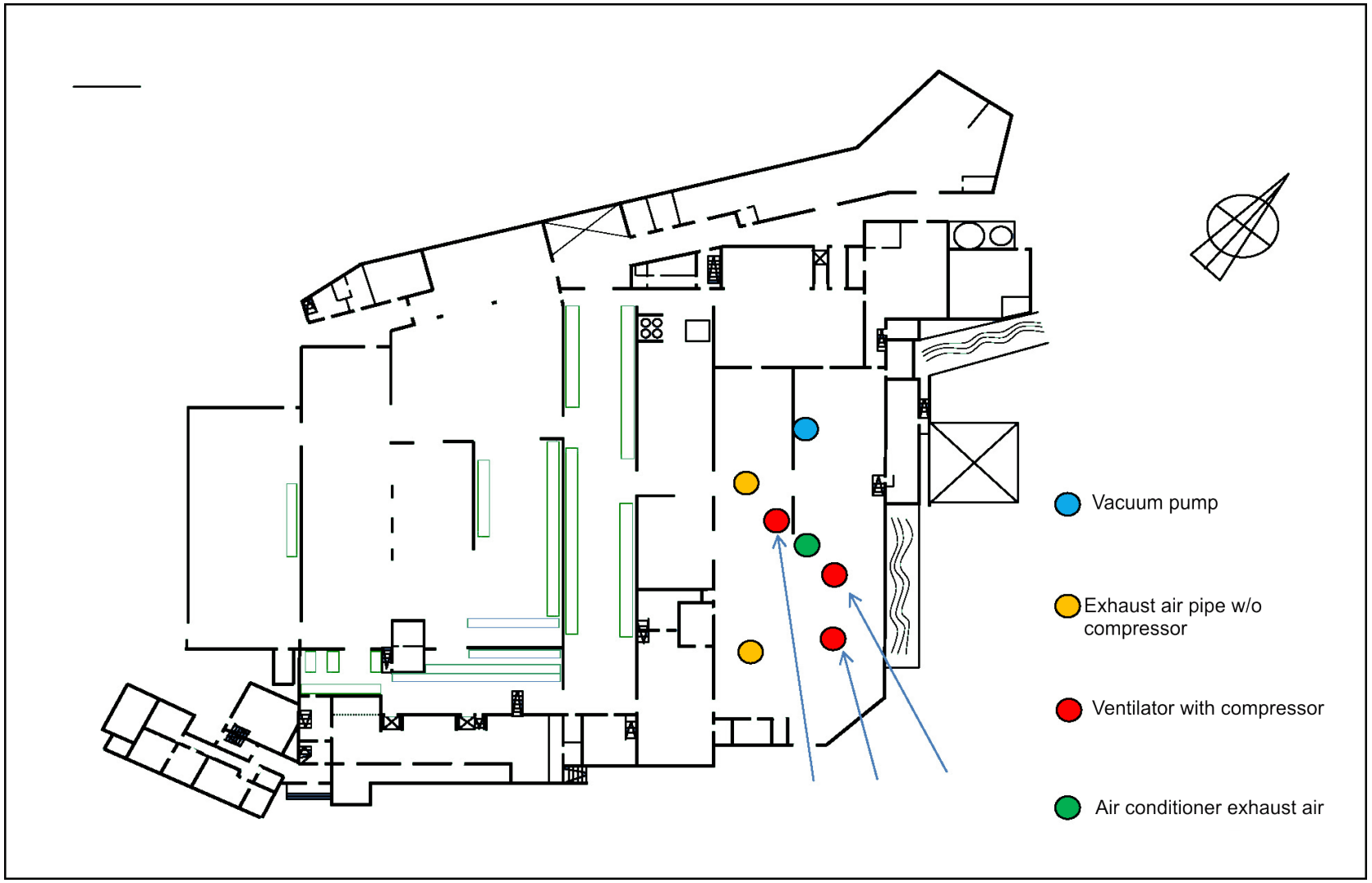
SCHEMATIC
VENT STACKS AND
POSITIONING OF THE SPRAY PIPE

Vent, exhaust air from cardboard drying

Vent

F1 . . . . . Sensor
F2 . . . . . Ventilator 2
F3 . . . . . Exhaust vapors outlet
F4 . . . . . Exhaust air factory building

VENT POSITIONING - OVERALL FACTORY LAYOUT



DESCRIPTION OF THE INSTALLATION PART 1

All relevant exhaust vents are bundled on the roof top and fed into the FERNETT Spray Tunnel Type EST-1

Photo: Example of exhaust piping into the spray tunnel

The spray tunnel can also be installed without any problems in the adjacent roof area.

Photo: Roof cardboard factory

Exhaust air purification takes places inside the FERNETT Spray Tunnel. Finely dispersed spray water washes the exhaust air inside the spray pipe. The spray pipe has a slight angle and includes an outflow for the spray water heated by the exhaust air on the lower side.

Following the spray pipe, the exhaust air exists the system cooled down and purified.

Photo: Spray water nozzles inside the spray tunnel create a water mist and purify the exhaust air

DESCRIPTION OF THE INSTALLATION PART 2

Arriving from the spray pipe on the roof, the spray water flows into the wastewater distribution basin of the FERNETT Spray Water Heat Exchanger. There, it is distributed evenly to all absorber levels within the heat exchanger.

Photo: Wastewater distribution basin inside the FERNETT Wastewater Heat Exchanger

The warm spray water flows downwards on the absorber plates inside the FERNETT Heat Exchanger on an open surface. Clean water flows inside the flat pipes located on the underside of the absorber plates absorbing heat from the spray water. Thus, the spray water is cooled down.

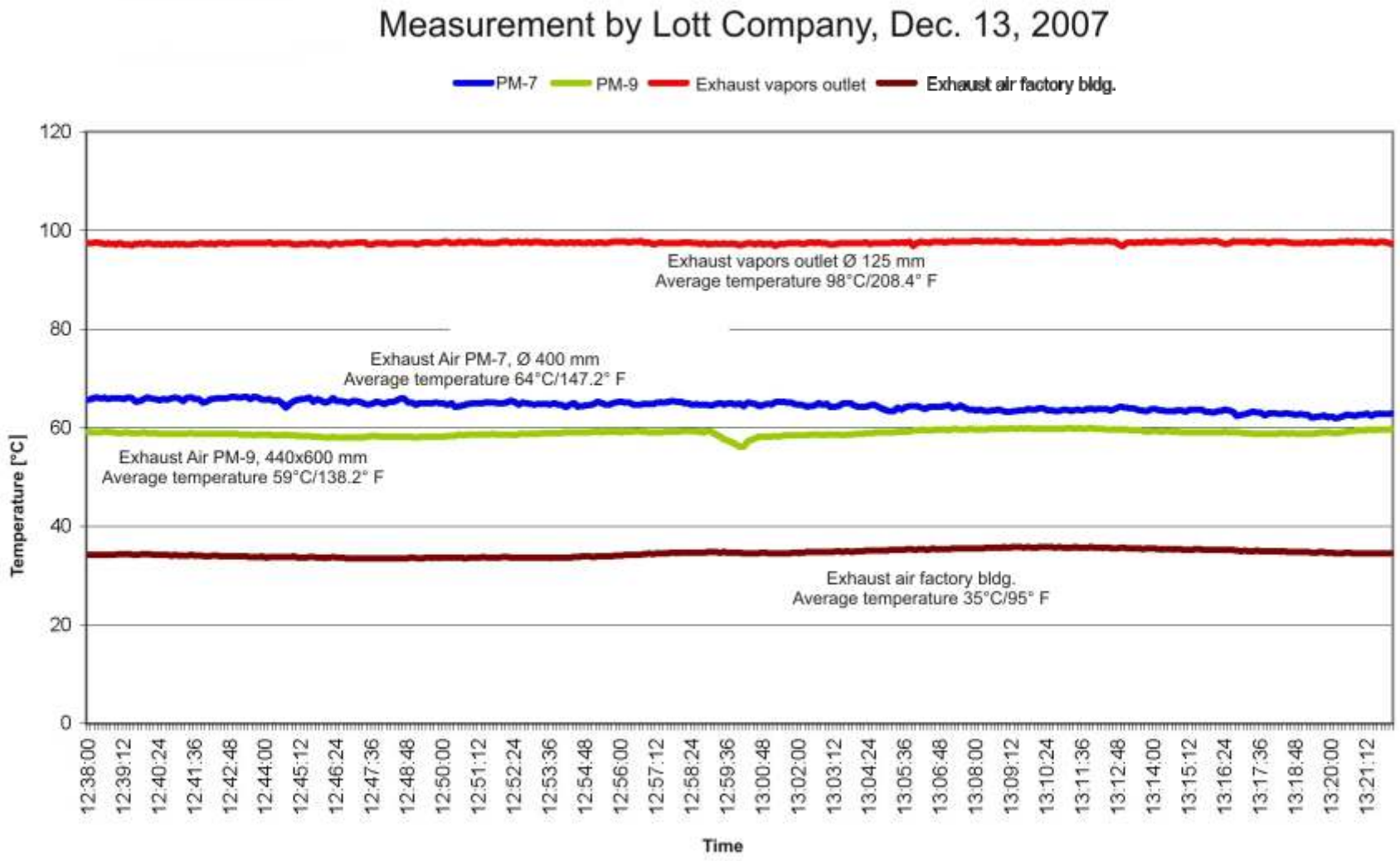
Photo: FERNETT Absorber Plates

After passing through the spray water heat exchanger, the spray water flows into a spray water basin. From there it will be pump back into the spray tunnel and is sprayed again.

The spray water basin includes an overflow into a second basin, which contains warm spray water to be used further during the process.

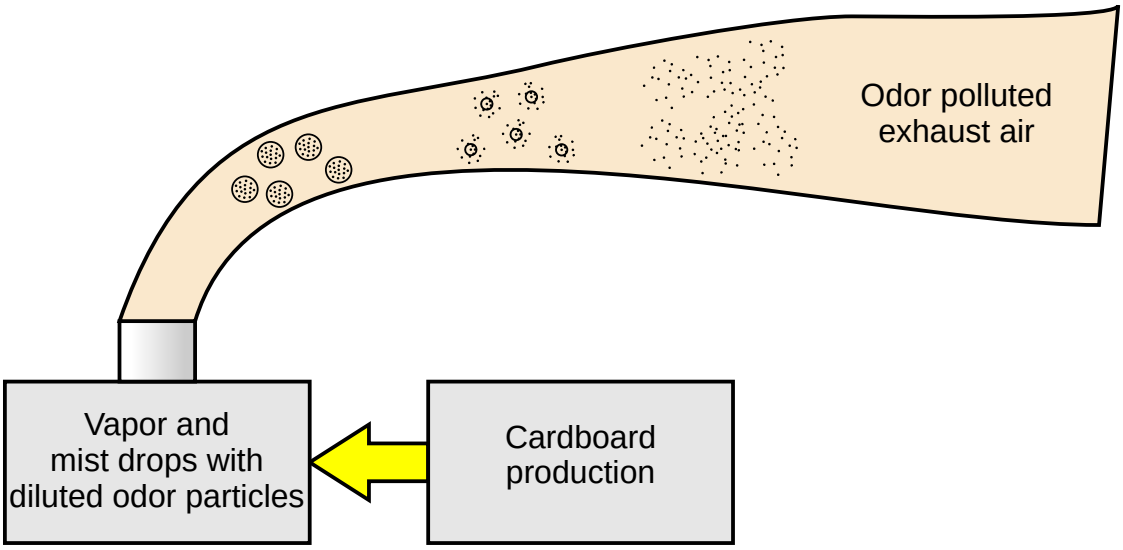
Photo: Spray water basin with spray water pump

DATA LOG DATED DEC. 13, 2007

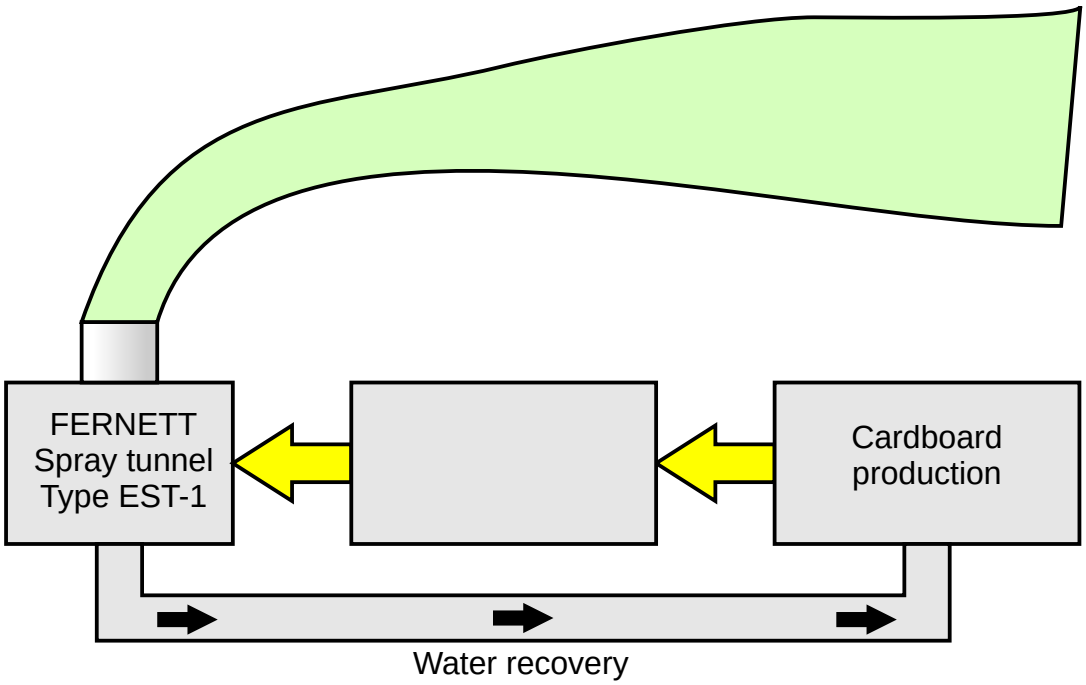


ODOR EMISSION REMOVAL

CURRENT SITUATION



NEW WITH EXHAUST AIR PURIFICATION



SUMMARY: ODOR CONCENTRATION AND VOLUME FLOW RATES

iMA
Richter & Röckle
Immissionen
Meteorologie
Akustik

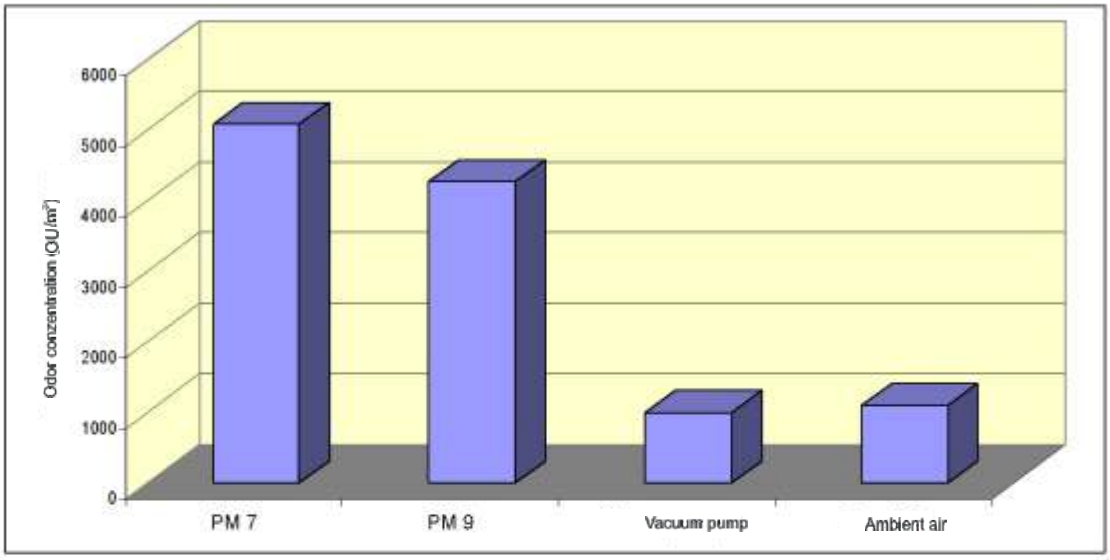


Figure 4-1: Odor concentration of the sources

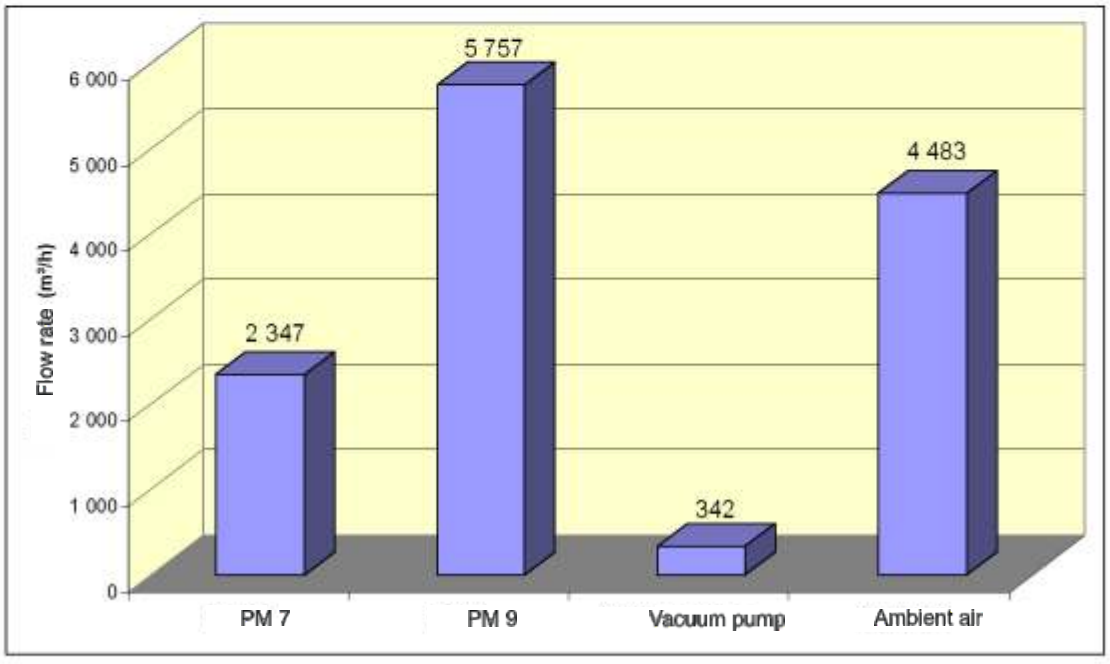
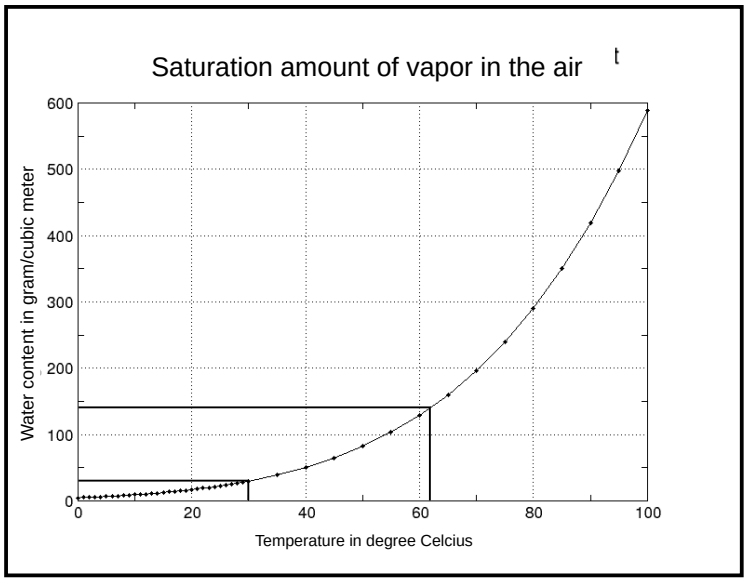


Figure 4-2: Source flow rate

PROGNOSIS FOR ODOR REDUCTION

Exhaust air - flow rate	
1. PM-7	2,347 m³/h
2. PM-9	5,757 m³/h
3. Vacuum pump	342 m³/h
4. Ambient air	4,483 m³/h
Total	12,929 m³/h



First assumption:

Exhaust air is saturated with water at 100%, odors are dissolved in vapor.

Exhaust air temperature is ca. 62° C/ 144° F (mixing temperature)
The FERNETT Spray Tunnel causes the exhaust air to be cooled down to ca. 30° C/86 ° F.

Due to the small saturation amount of water in air with low temperature, a certain water amount condenses from the air, in this case 110 gram water per cubic meter air (see diagram saturation amount of water vapor in air).

With a total exhaust air flow of 12,929 m³/h (456,583 ft³/h), this equates to a condensation amount of net 1,422 m³/h (50,217 ft³/h) for the production of ca. 1 m³/h (35 ft³/h).

Odor units (OU) of the joint exhaust air prior to entering the spray tunnel:
(2,374 m³/h * 5,000 + 5,757 * 4,000 + 342 m³/h * 800 + 4,483 * 900) / 12,929 m³ =
ca. 3,000 OU/m³
(83,837 ft³/h * 5,000 + 5,757 * 4,000 + 342 m³/h * 800 + 4,483 * 900) / 12,929 m³ =
ca. 3,000 OU/m³

The required maximum amount is 200 OU/m³ (35 ft³/h).
200 / 3,000 = 6.67 %

Model:

3,000 OU are contained in the water vapor in the exhaust air.

1.) Due to condensation from 140 g/m³ to 30 g/m³	30 / 140 = 21%
2.) Due to condensation and feed into the spray system	30 / 454 g/m³ = 6.67%

140 g/m³.....condensation
314 g/m³.....spray system wash-out
Spray water amount 0.314 kg/m³ * 12,929 m³/h = 4,060 kg/h

PERFORMANCE CALCULATION

Basic data:

The exhaust air amounts to ca. 12,000 m³/h (423,776 ft³/h).

The exhaust air enters the FERNETT Spray Tunnel at a temperature of ca. 62° C/ 144° F and exits cooled down and purified at a temperature of ca. 30° C/86° F.

The difference thus equals 32° C/89.6° F.

Formula:

The density of air is 1.15 kg / m³.
The specific heat capacity of air at 100% relative humidity = 1.03 kJ / (kg K)

P = M / 3600 * 1.15 * cp(air) * 32 =
12,000 / 3,600 kg/s *1.15 * 1.03 * 32 = ca. **109.9 kW**

Calculation of the circulation amount for the buffer tank circulation:

P = M * cp * dT
M = P / (cp * dT)
M = 109.9 / (1.16 * 13) = ca. 7,29 m³/h
M = 109.9 / (1.16 * 18) = ca. 5,26 m³/h

The required circulation amount thus equals between ca. 5.25 and 7.25 m³/h.

The spray water surplus for the process (from the second spray water basin) amounts to ca. 1 cubic meter per hour at a temperature of 20 to 25° C/68-77° F.

General remarks:
All above values are approximate. The basic data was gathered by measurements at the facility and in the technical literature.