



Photo 1 : A view of a typical laboratory.

How to Prevent Mixing of Flavors & Fragrances in an Air Conditioned Lab

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This one was an unusual enquiry ! Could we design and install an air conditioning system for a 17,500 sq ft laboratory in Mumbai for an eminent manufacturer of fragrances and flavors. One of the challenges in the system design was to ensure that "smells" get diluted, do not mix, and that both the products-fragrances and flavors- generated inside laboratories did not enter the exhaust air stream to the atmosphere, so that persons working in the neighborhood did not have a reason to complain to the city authorities.

Located on an entire floor in a commercial building, with several other offices in the building, the laboratory was divided into two wings. One wing was for perfumes or fragrances, such as used in hair shampoos, soaps and agarbattis and the other for flavors, such as in cakes and biscuits, and in between was a zone for the reception, meeting rooms, conference

room and offices. Entry into the two wings was through airlocks, to be maintained at a highly negative pressure that would form a barrier to prevent smells from the two laboratory wings to enter the reception and office areas. See Figure 1.

Another demand was that no floor space in the entire lab and office could be used for placing air handling units, nor was permission given by the building owner for installing a cooling tower or a chiller package. The noise level in all air conditioned areas had to be less than 50 dB.

Essential Features for Smell Control in AC Systems

There are some essential features that must be incorporated in the design of the air conditioning systems for handling smells.

- To prevent buildup of smell in the conditioned area, smell dilution needs to be done using make-up fresh air. Harsher smells or more quantity of smell will need more make-up air for dilution.

- Perfumes or essences need to be dispensed at locations under exhaust hoods to minimize the spread of the smells in the room.

- Zones dealing with different smells will need to have separate air-conditioning systems, so that smells of various zones do not mix.

- The common corridor opening into the various zones must be at a higher pressure so that when room doors open, corridor air gets into the room and not vice-versa. The common corridor is 'smell neutral'.

- Though it would be ideal to have air-locks separating the rooms from the corridors, in most cases this is impractical, considering the way lab personnel move

About the Author

B. Gautham Baliga has been in the air conditioning industry for the last 29 years. He has a bachelor's degree in mechanical engineering from IIT Kharagpur. He is a member of ISHRAE and past president of Mumbai chapter.

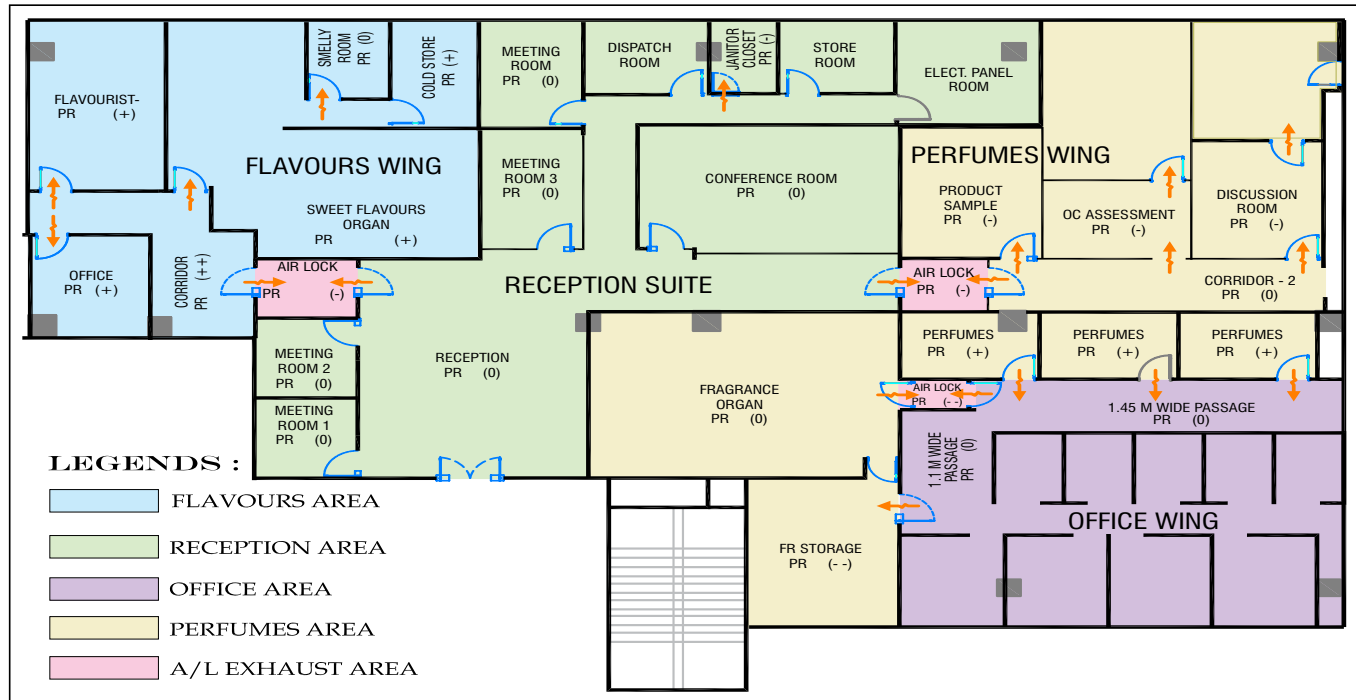


Figure 1: Typical zoning & pressure gradient diagram

around with bottles and vials in their hands. In most cases they manipulate the doors with their legs, as their hands are not free!

- The smelliest rooms need to be at the highest negative pressure to ensure that these smells do not get into other rooms.

Room Construction

The materials used for construction of rooms should be such that they do not absorb smells. Otherwise, the absorbed smells will be given out all the time and the room will turn out to be smelly.

Typically, glass and metals are used in abundance for partitions. False ceilings are of metallic construction instead of, say, gypsum board or compressed mineral fibres. Carpets are not to be used as they absorb smell.

The doors are gasketed so that there is very little gap between the door and doorframe. This ensures that very little infiltration or ex-filtration of air takes place due to pressure gradients between rooms.

All partitions go till the main ceiling and all apertures for cables, plumbing and ducts are carefully sealed. The gaps between diffusers & lights and false ceiling too are carefully sealed to prevent leakage of smell from one zone to another.

Fresh Air and Exhaust Air Must Not Mix

The locations of fresh air intake and exhaust air outlet is critical. It is imperative that these are physically as far apart as possible. Prevalent wind directions will need to be taken into consideration to ensure that there is no possibility of short cycling of exhaust air into the fresh air intake.

Treatment of Exhaust Air

In order to ensure that there is no 'smell pollution' into the neighborhood, exhaust air systems need to incorporate activated carbon filters.

Salient Features of the Installation

- **Ducted Supply & Ducted Return.** Having false ceiling return was avoided as possibility of air mixing above false ceiling between zones could not be ruled out.
- **Ceiling Suspended Air-handling Units.** In view of the ducted supply and return and because pressure gradient was a criteria, all systems had separate air-handling units. Paucity of space resulted in these units being ceiling suspended.

A Primer on Smell

Smells are chemicals that get carried by air. The olfactory system detects volatile organic compounds in the chemicals present in air. The chemicals themselves, which activate the olfactory system, generally at very low concentrations, are called odors.



Smells are sensed by olfactory sensory neurons in the olfactory epithelium in the nasal cavity.

Humans have about 10 cm² of olfactory epithelium, whereas some dogs have 170 cm². A dog's olfactory epithelium is also considerably more densely innervated, with a hundred times more receptors per square centimeter!

Most untrained human noses can recognize 500 smells. Experienced perfumers have the astonishing ability to identify and catalogue more than 10,000 distinct smells. It is for this reason that it is important that their labs should not have build up of smells and mixing of various smells in order to ensure that they can go about their work efficiently.

continued from page 66



Photo 2 : A view of an array of hair dressing saloons separated by glass partitions to check shampoo fragrances

- **Air-cooled Condensing Units.** The laboratory did not have permission for installing chiller package. As a result, each air-handling unit had its condensing unit(s). In all there were 16 independent air conditioning systems for all the areas.

- **Sound Attenuators for Supply & Return Air.** Since the air-handling units were very near the respective conditioned areas, sound was a critical issue. The client wanted all areas to be less than 50dB. All air-handling units had silencers for the main supply & return air duct.

- **Re-circulatory Air Systems.** Ideally, considering smell dilution issues, a once thru' system would have been ideal. This could have been viable when used along with energy recovery wheels. However, considering the space available above the false ceiling, this was not found to be feasible.

In view of the fact that we could have only re-circulatory systems, the client referred to their in-house codes and came up with the following table of make-up fresh air requirement for dilution ventilation:

Area Designation	Fresh Air/Make-up Air Changes per hour
Flavourist	6
Smelly Room	8
Sweet Flavours Organ	4
Product Organ	4
Product Sample	6
OC Application & OC Organ	1
Perfumers	20 (no re-circulation)
Fragrance Organ	3
FR Storage	1

Table1: Typical makeup air requirements for dilution ventilation

- **Central Fresh Air & Exhaust Air Systems.** Each of the two wings have a central fresh air & exhaust system. This system has a two-fold function viz. providing dilution ventilation and providing pressure gradient.

One of the shortcomings of a common central system is that when the systems are switched off, the connected ducts provide a passage for mixing of air, and thus smell. To obviate this possibility, all fresh air and exhaust air connections to respective systems were provided with motorized dampers, which shut close when the systems are switched off.

- **Air-conditioning for Special Rooms.** There were two sets of rooms that needed special consideration:

Perfumists Room These are the most critical rooms where the perfumists grade the products. These were provided with once- thru' air-conditioning system. Another important detail is that these rooms are kept at the highest pressure with respect to surroundings to ensure that no outside smells come in.

Shampoo Saloons Here, in a suite of eight cubicles, shampoo is applied on the hair of mannequins and the perfumist checks the smell by opening a hatch in the common corridor. After the

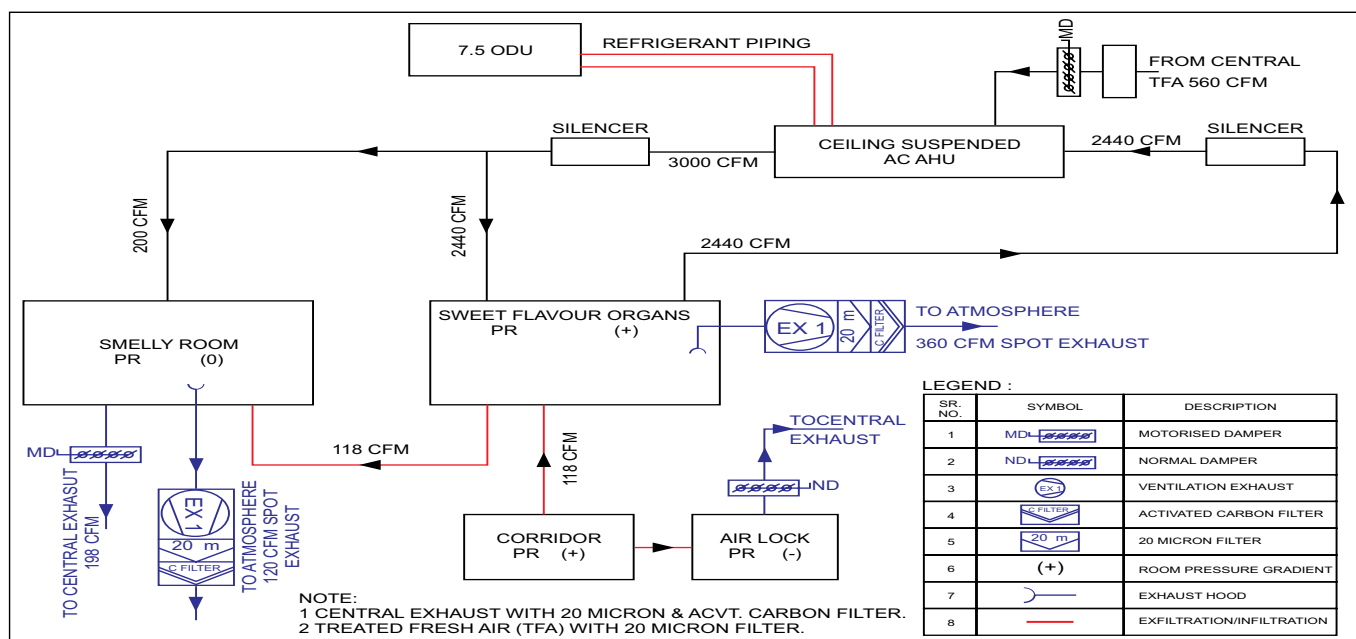


Figure 2: Typical air flow schematic

