Living with traffic and industrial pollution

The in a typical home inside air leaks out and outside air leaks in, typically resulting in new air from the outside replacing the existing air inside every hour or so.

This is not a design fault, without a substantial amount of air circulating between the outside and inside our homes can become “sick”, with condensation and mould damaging the walls and fabric of our houses, aggravating allergies and complicating respiratory diseases brought on by certain biological agents such as mites and mildew.

This then is the conundrum, we need air to circulate from outside to inside, but in areas with high external pollution that circulation continuously brings outside pollution into our homes.

Outside vs Inside

Outside, Nature wages a powerful war of attrition against atmospheric pollution.

Wind disperses pollution, diluting its local effects. Natural chemical and photochemical interactions create an abundance of ‘hydroxyl radicals’ (known as ‘Nature’s Detergent’ by scientists) which attack and neutralise a wide range of pollutants, and rain and snow wash pollution and its by-products out of the air.

Of course, in the urban environment, pollution can build up where it is created more quickly than nature can remove it.

Inside, the natural conditions which create hydroxyls are absent and pollution, well, it hangs around for us to breathe it in!

What does the pollution consist of?

Before deciding on an effective strategy for reducing pollution leaking in from outside, it is necessary we understand the scope and nature of the pollution we are attempting to neutralise.

Historically, the main air pollution problem in both developed and rapidly industrialising countries has typically been high levels of smoke and sulphur dioxide emitted following the combustion of sulphur-containing fossil fuels such as coal, used for domestic and industrial purposes.

These days, the major threat to clean air is now posed by traffic emissions. Petrol and diesel powered vehicles emit a wide variety of harmful pollutants, principally

carbon monoxide (CO), oxides of nitrogen (NO_x), volatile organic compounds (VOCs) and particulate matter ($PM_{2.5}$). Additionally, the photochemical reactions resulting from the action of sunlight on nitrogen dioxide (NO_2) and VOCs creates ozone.

- **Carbon Monoxide (CO)**

  CO (carbon monoxide) is a dangerous, colourless gas which reduces your blood's ability to carry oxygen and can make you ill.

- **Oxides of Nitrogen (NOx)**

  The Committee on the Medical Effects of Air Pollution recently reviewed the evidence for the adverse health effects of NOx and concluded that:

  - Short-term exposure to NO2 likely causes respiratory ill health; may causes an increase in hospital admissions for heart problems; may cause an increase in overall mortality.
  - Long-term exposure to NO2 may cause an increase in respiratory and cardiovascular mortality, children's respiratory symptoms and decreased lung function.

- **Volatile Organic Compounds (VOCs)**

  VOCs include a variety of chemicals, some of which can have short- and long-term adverse health effects.

- **Ozone (O3)**

  Ozone can trigger asthma attacks and cause shortness of breath, coughing, wheezing, headaches, nausea, and throat and lung irritation, even in healthy adults.

- **Particulates ($PM_{2.5}$)**

  Particulate matter, also called PM or soot, consists of microscopically small solid particles or liquid droplets suspended in the air.

  $PM_{2.5}$ refers to what are termed "**fine particles**" of below 2.5 microns in diameter.

  The smaller the particles, the deeper they can penetrate the respiratory system and the more hazardous they are to breathe.

  Ultrafine particles (UFPs) are particulate matter of nanoscale size (less than 0.1 microns in diameter). **UFPs are the main constituent of airborne particulate matter**. Owing to their numerous quantity and ability to penetrate deep within the lung, UFPs are a major concern for respiratory exposure and health.

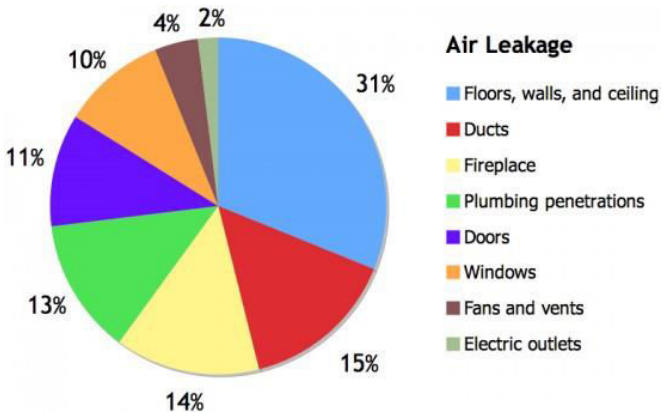
PM pollution can cause lung irritation, aggravates the severity of chronic lung diseases, causes inflammation of lung tissue, causes changes in blood chemistry and can increase susceptibility to viral and bacterial pathogens.

The challenge then is to remove or neutralise these pollutants more quickly than new ones enter the room.

Step 1 - Reduce air leakage

The first step that we can take to improve matters is to reduce the quantity of pollution coming inside.

To do that really well we would have to start from scratch and build homes according to a whole new set of rules, such as the 'Passivhaus' standards which employ mechanical ventilation to clean the incoming air in a controlled manner.



For most of us that is impractical (and unaffordable!), but we can (if it hasn't already been done) do a lot to improve the situation by using the well understood techniques for sealing and ventilating that were developed to save energy. Click here for a good basic guide on what can be done to both save energy (and money!) and reduce air leakage.

However, simply reducing leakage won't solve the pollution problem. Reducing leakage by, say, 50% won't really help in pollution terms, the air inside will still be as polluted as the air outside, but the lower the leakage rate the more effective the use of air cleaning technology will be.

Think about it this way, sit an air cleaner, however effective, next to an open window and it will be overwhelmed by new pollution to the point where it will have no effect. For an air cleaner to be effective you have firstly to slow the flow of new air into a room to give it time to work.

So, reducing leakage is only the first step in mitigating the pollution problem, using an air cleaner that really works is the second!

Step 2 – Remove or neutralise internal pollution

Having reduced air leakage, let's look at how polluting gasses and particulates might be removed or neutralised before we breathe them in.

Can filters reliably remove or neutralise all of CO, NOx, VOCs and O3?

X *No! CO, NOx, VOCs and O3 are gasses that cannot be filtered out by HEPA, Ionising (Ionic) or Electrostatic (Electronic) filters, which are all designed to filter out particulates, not gasses.*

What about activated carbon filters?

These are sometimes suggested to remove these gasses from the air and can be implemented either as stand-alone filters or in combination with a HEPA filter to capture the larger particulates.

The problems with this type of filter in this application are many, including:

- budget (and sometimes expensive!) versions may have only a thin layer of carbon, which makes them ineffective
- the speed of the air through the filter is often too high (so as to achieve a high air flow rating) giving the carbon too little time to be effective
- the filter becomes 'saturated' and ineffective without the user being able to tell that is the case – and users cannot rely on the manufacturer's 'average' replacement times in areas of high pollution
- according to the EPA, gas-phase filters, like activated carbon, cannot readily remove carbon monoxide from the air
- filter replacements, which are typically expensive, need to be frequent to ensure they don't become saturated
- O3 chemically alters the carbon, reducing its efficiency, and requiring even more frequent filter changes

X *So, all in all, activated carbon filters are not effective as a solution for removing gaseous pollutants.*

OK, how about HEPA filters?

The 'gold standard' for particulate filters is the High Efficiency Particulate Air (HEPA) filter. Filters meeting the HEPA standard remove 99.97% of particles that have a size 0.3 microns or larger from the air passing through them.

However, 90% of particulates in the air, including the most harmful ones, are smaller than that, so most HEPA air purifiers only catch a fraction of all particulates, and none of the potentially most harmful ones.

X *Hepa Filters will only remove 10% of the particulates.*

So, filters simply aren't effective at removing industrial and traffic pollution?

Correct. And air filters don't work well in the real world anyway! Not only are there no suitable and affordable filters for the purposes we require, the unfortunate

fact is that portable air filtration devices, of whatever type, are not very effective at treating any kind of pollution.

All portable air filters share the same fundamental shortcoming; that even if they do filter the air passing through them effectively, ***they only clean that limited amount of air that passes directly through them, not all of the air in the room.*** You can find out more here.

Then along came Airora…

Let us return to where we started, outdoors;

Outdoors, nature wages a powerful and successful war of attrition against atmospheric pollution by employing natural chemical and photochemical interactions to create an abundance of 'hydroxyl radicals' (known as 'Nature's Detergent' by scientists) which attack and neutralise a wide range of pollutants.

But hydroxyls are only created naturally outside.

Airora is the only technology that can create that same safe and effective Hydroxyl Cascade inside your home, destroying or neutralising all the key types of gaseous pollutant (CO, NOx, VOCs and O3) and, over time, vaporising key harmful ultra-fine particulates.

Airora is not a filter, the air to be cleaned does not have to pass through the device, the hydroxyls spread throughout the air in a room in seconds by molecular diffusion, reacting with and destroying pollution as they go.

Find out more about how Airora breaks down harmful gasses and vaporises key harmful ultra-fine particulates that are too small to be trapped by HEPA filters here.