

Focus on hygiene in dental compressors

Scientist warns of risk of bacterial growth in compressed air receivers

Having the familiar blast of air from your dentist during treatment, hardly anybody realises that it may be contaminated air that is blown directly into your mouth. Finn Djurhuus, head of section at DTI Industri, Danish Technological Institute in Aarhus, points at a source of contamination only few dentists have been aware of until now: their compressors.

Recently, we tested the compressors in four Danish dental clinics and the results we came up with were quite frightening. Problems caused by bacteria in the oxygen in water have been identified and dealt with for many years but only a few people have thought about the connection to compressed air.

More than 80% of all compressors in Denmark do not comply with current quality requirements under all working conditions

Condensate from the compressor should be lead out of the clinic. In the industry, we have diagnosed cases of illness among workers who have been exposed to exhaust air from compressed air components where the humidity in the receiver has been very high. We cannot eliminate the possibility that some cases of illness in dental clinics are caused by compressed air. Condensate that ought to be drained every day must be treated with the utmost care as tests show that it may contain a large concentration of bacteria. In cases where air leaks out of hoses and couplings it is a fact that a germfilled environment may be created. It is not unusual to find as many as 6 to 10 million germs per millilitre of compressor condensate. If we, theoretically, imagine that leaks in a hose system permit these particles to enter into the compressor again and again to be sent into the compressed air system, a concentration of 70 million germs might be reached.

No specific dental requirements

Only recently, attention has been drawn to hygiene in dental compressors. Dentists in Denmark are not obliged to observe the regulations in Aer Medicinalis. However, views in Pharmaca Europae suggest that this will be standardized soon. The American standard NFPA 99 from 1990 has a chapter about dental clinics but it does not mention compressed air. As yet, no directives from the Danish National



Finn Djurhuus, chief adviser and head of section for DTI Industri in Aarhus, has worked with standardization, designing of systems, service and maintenance, and quality measurement of compressed air for more than 25 years. He is the author of several articles for national and international magazines on the subject "quality control of compressed air" and is member of a number of standardization committees.

Board of Health have been published. But in view of the general Danish spirit and environmental attitude, this is likely to be looked into very carefully by the Environmental Department. Bacteria blown directly into an open wound are of course hazardous to your health - ordinary bacteria might be acceptable but when dealing with enterobacteria, salmonella, listeria, coli etc. the effects are much more serious. The enterotoxins, poisonous substances originating from the bacteria, pass filters above 2 nanometer but a filter with filtration degree of less than 2 nanometer does not exist. Therefore, we have to create conditions making the existence of these bacteria impossible including a relative humidity percentage of below 50.

The Monday test

Finn Djurhuus continues: We have focused on the food chain of bacteria nourished, cultivated and maintained in some dentists' air receivers. It is, therefore, important that steps should be taken to avoid accumulation of condensate in the compressed air tank of the compressor. This is to be inspected and emptied of possible condensate daily. The proof of an unclean receiver may be an unpleasant odour from the triple syringe the first time this is used after for instance a weekend. When clean blowing the syringe, the air receiver should be emptied of water and cleaned

of impurities - the latter often ignored due to either lack of knowledge as to the necessity of this or the rather extensive job that this entails - cleaning a receiver internally is a complicated affair.

Air intake is extremely important

Many compressors are placed in a basement - perhaps even in the boiler room where the temperature nourishes bacterial growth. Several compressor intakes are placed close to the exhaust of other machinery or close to a busy street where the car exhaust is mixed with the air and compressed. We have also seen examples where the accumulation tank from the suction unit from several chairs has been placed very close to the air intake of the receiver. Small leaks in the suction system might then effect the air quality seriously.

Danger of corrosion

Increased germ flora and high air humidity will cause increased corrosion of the receiver resulting in rust. At 50% relative air humidity corrosion is hardly to be measured whereas at 60-100% relative air humidity we talk about a vertically progressive increase also resulting in contamination of the receiver, i.e. sludge at the bottom of the receiver. The corrosion rate in a receiver corresponds to 120 g per m² per 100 hours.



Compressed air sample from oil lubricated compressor without drying of the air. After cultivation a large concentration of various germs was discovered.

Maintenance of filters

It is not unusual for compressor filters not to be replaced in accordance with the manufacturer's directions. Even if these directives are available. Filters on the chair in the clinic are often replaced as directions prescribe. But it is just as important to replace the filters on the compressor. The filter in the clinic is only effective for filtration of the largest impurities and does not live up to the standards otherwise in force for hygiene in dental clinics.



Compressed air sample from oil less compressor with adsorption air dryer. After cultivation no bacteria was to be found.

Why is there no corrosion of old compressors?

Because they are oil-lubricated. The oil works as a kind of "undersealing" of the receiver. Unfortunately, this prolonged life time also causes a major risk of increased contamination - a fact not many dentists are aware of. Oil and air for inhalation have never been a good combination. Therefore, we welcome the oil-less compressors and in particular the newest compressor types with adsorption air dryers.

Larger amount of water than most people realize

The quality of the air is no better than the maintenance of the compressor, Finn Djurhuus continues. Condensate reduces the efficiency and increases the risk of bacterial growth. In our example, a compressor compresses 1 m³ per minute to 7 bar. The temperature is 2°C (77°F), the relative humidity is 84% (average in Denmark) at which conditions 19.2 g water is taken in and compressed to 7 bar / 100 PSI (8 bar / 115 PSI absolute) i.e. relatively there is only room for 2.9 g resulting in 16.3 g water for condensate per m³. If a work day is 8 hours, we have 16.3 g water x 60 minutes x 8 hours = almost 8 1 / 2 gallons of water - A DAY.

Analysis methods?

It is easy to refer to water analyses with fine results. But nobody has ever come up with a solution to how the contents

of a receiver should be analysed. Measurements are carried out correctly but the procedures are incorrect! One of the reasons is that organisms removed from receivers get the bends when exposed to ordinary atmospheric air and most of them die. Then this inactive environment is tested and some bacteria, therefore, are not revealed. If the test were carried out under pressure, the results would probably be quite different. The temperature should of course also be similar to normal working conditions.

Refrigerated dryers are not effective enough

A refrigerated dryer is for cooling and drying of air. The first part is correct but cooled air has a high relative humidity in a refrigerated dryer, approx. 100% at 2°C / 36°F, i.e. anything but dry. If the humidity is not removed prior to leading the compressed air to the consumption place, bacteria and micro organisms continue to grow. A wrong test result might also be achieved by cultivation of bacteria at 27°C / 81°F since bacteria not withstanding this temperature will not survive - however - these are bacteria that might well be active at lower temperatures in the cool dryer whereas the results only show bacteria living in an entirely different environment.

The ideal compressor set up is already available

Despite the fact that oil-less compressors were introduced several years ago, my experience is that many dentists continue to use traditional oil-lubricated industrial compressors, Finn Djurhuus states. However, this is most inadvisable since only use of an oil-less compressor ensures totally clean air - without the inconveniences and risks caused by oil remnants in the compressed air. Therefore, even with the most modern and efficient filter combinations there is a risk of oil carry over in the air from an oil-lubricated compressor in the event of lack of maintenance. For drying of the air, I recommend adsorption air dryers with filters which in my opinion is the best solution. The new adsorption air dryers ensure low levels of water vapour in the compressed air, particularly the types with 2 chambers where one is regenerating while the other adsorbs moisture. These dryers reach a pressure dew point of minus 4°C corresponding to air having to be cooled to this temperature prior to possible condensation taking place. The water vapour has, consequently, been adsorbed to a degree where the risk of growth of micro organisms has been eliminated.

Unhealthy ventilation air started the project in 1978

Quite early, I became aware that the contaminated air found in ventilation units is also to be found in compressed air as well - even in a very compressed environment. This resulted in several projects, the first of which was finished in 1984. Professionally, we were met with interest and we applied for more funds. Unexpectedly, we were helped by one of the micro organisms, i.e. listeria, that was found in the production of cheese and was exposed with an enormous interest both from the public and from the medias. Renewed applications resulted in more funds for continued research from 1988 to 1992 - the last years' focus on salmonella has also meant increased interest in our project.

3 conditions ensure good and clean compressed air for the health sector:

1. Correctly sized oil-less compressor with adsorption air dryer and filters
2. Must be placed where the air taken in is clean, i.e. free of basic substances, and cool
3. Daily maintenance to be carried out in accordance with the manufacturer's directions

The compressors of the future

Any kind of water, even a few drops is too much in compressors where the exhaust air has direct contact with human organs. It is, therefore, of the utmost importance that units ensure that there is no oil or condensate in the compressed air receiver. The most efficient method is the combination of an oil-less compressor with dryer. Consequently, the pressure dew point - i.e. the dew point of the compressed air in the receiver (at a pressure of 7 bar / 100 PSI) - does not exceed -21°C / -6°F, not to be confused with the atmospheric dew point which at the same time will be approximately -42°C / -45°F.

The perfect compressor should be accompanied by an easily read directions for use which may sound logical but unfortunately this is not always the case. Obviously, replacement of filters and maintenance should be dealt with according to the directions of the manufacturer.

- said Finn Djurhuus, chief adviser and head of section at DTI Industri, Centre for Product Development at Dansk Teknologisk Institut.