Compressed Air Contamination in the Food Industry

Compressed Air: An Overlooked Source of Contamination in the Food Industy

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Compressed air is used in a broad range of applications in the food processing industry such as mixing of ingredients, cutting, sparging, drying of product, transporting/propelling product through processing systems and packaging of final product. In many of these applications, compressed air is in direct contact or indirect contact with food product and the impurities in the compressed air may contaminate the food product which can result in change of color and taste, reduced shelf life, in addition to exposure to bacteria and other micro-organisms can result in product recalls.

Compressed air, which is generated on site by pulling in ambient air and compressing it, contains water vapor, particulate matter (atmospheric air typically contains 140-150 million dirt particles/m^3)[1] oil vapor and droplets and microorganisms such as bacteria, viruses, fungi and spores (atmospheric air can contain up to 100 million microorganisms/m^3)[2] In addition, compressed air will also contain liquid oil, oil aerosols and oil vapor which leak in through worn seals, orifices and o-rings within the compressor. Since the compression process raises the temperature of the air, the air is then cooled before use, which condenses water vapor into water aerosols and droplets. Water in the compressed air can produce rust and corrosion in the piping which flakes off and is carried downstream, potentially contaminating the food product. In addition, water condensate and warm compressed air provides the ideal environment for microbiological growth, growth of bacteria, spores and mold.

More and more food processors employ the principles of HAACP (Hazard Analysis and Critical Control Point) and a risk analysis, ISO 8573.1, FDA and other government regulations to ensure that the production areas and personnel are maintained at an acceptable level with regards to food safety/quality and sanitation. However, in most facilities, compressed air is considered a utility that is as clean as the facility's ambient air, however, it is not. More importantly, the filtration systems that are employed are designed to protect process equipment from large slugs of water, oil, rust and pipe scale with a nominal rating of 25 to 40 micron and are not capable of removing submicron contaminates such as bacteria and other micro-organisms.

If, the HACCP analysis – risk analysis, is pursued in detail, every location in which compressed air is used, would be correctly identified as CCP or critical control point. This is true whether it comes in direct contact or indirect contact with the food product. Unfortunately, there are no standards or laws that exist that define a minimum acceptable level of "cleanliness" (filtration specification) when compressed air is used in the manufacturing of food. As a result, most companies devise their own internal compressed air quality "standard" or "specification". The most common standard that is used is the ISO8573.1-2010 in conjunction with section 6 of The Code of Practice that was co-jointly developed by the British Compressed Air Society (BCAS)[3] and the British Retail Consortium (BRC)[4]

Section 6 of this Code defines 3 separate categories of compressed air as used in the food industry.

- Direct contact with food
- Indirect contact with food or Non-contact, high risk
- Non-contact – no risk

The ISO specification for compressed air, ISO8573.1-2010 is presented below.

ISO8573-1:2010 CLASS	Solid Particulate				Water		Oil
	Maximum number of particles per m^3			Mass Concentration mg/m^3	Vapor Pressure Dewpoint	Liquid g/m^3	Total Oil (aerosol liquid and vapor) mg/m^3
	0.1 - 0.5 micron	0.5 - 1 micron	1 - 5 micron				
0	As specified by the equipment user or supplier and more stringent than Class 1						
1	≤ 20,000	≤ 400	≤ 10	-	≤ -100°F (-70°C)	-	0.01
2	≤ 400,000	≤ 6,000	≤ 100	-	≤ -40°F (-40°C)	-	0.1
3	-	≤ 90,000	≤ 1,000	-	≤ -4°F (-20°C)	-	1
4	-	-	≤ 10,000	-	≤ +37.4°F (+3°C)	-	5
5	-	-	≤ 100,000	-	≤ +44.6°F (+7°C)	-	-
6	-	-	-	≤ 5	≤ +50°F (+10°C)	-	-
7	-	-	-	5 - 10	-	≤ 0.5	-
8	-	-	-	-	-	0.5 - 5	-
9	-	-	-	-	-	5 - 10	-
X	-	-	-	> 10	-	> 10	> 10

For direct contact applications, section 6 of The Code recommends a class rating of 1.2.1
For indirect contact applications, a class rating of 1.2.1 is recommended
For non-contact, no risk applications, a class rating of 1.4.1 is recommended

It is possible to achieve these class ratings and air quality specifications if proper care is taken to select and install high performance compressed air dryers and filter systems that are properly sized and installed in strategic locations throughout the facility.

Most facilities have a large dryer installed in the compressor room which will achieve the -40°F dew point specification. These should be monitored periodically for performance to specification and maintained regularly. However, most facilities do not have proper filtration installed at the critical control points.

In order to achieve the filtration specification as outlined above, it is necessary to install at least a two stage filter system as close as possible to the point of use. If there is excessive condensate, a third stage, prefilter stage should also be installed.

A typical system should consist of a first stage, high efficiency coalescing filter with a rating of at least 99.99% at 0.01 micron which provides the necessary protection to the second stage of filtration – the sterile air filter. A sterile air filter with an efficiency rating of at least 99.9999+% at 0.01 micron is necessary[5] in order to achieve the class 1 rating and safeguard food product from becoming exposed to bacteria and other micro-organisms.

Sterile air filter systems should be manufactured in full compliance with FDA requirements and accepted by the USDA/FSIS for use in federally inspected meat and poultry plants.

Installing high efficiency sterile air filter systems at critical control points will ensure contaminate free food product resulting in improved shelf life, reduced recalls, and enhanced food quality and safety.

References

1 High Quality Compressed Air for the Food Industry, Parker-Hannifin Ltd. Industrial Division, Gateshead, Tyne and Wear, England, Catalogue 1740004425_02:2010

2 High Quality Compressed Air for the Food Industry, Parker-Hannifin Ltd. Industrial Division, Gateshead, Tyne and Wear, England, Catalogue 1740004425_02:2010

3 http://www.bcas.org.uk/

4 http://www.brc.org.uk/brc_home.asp.

5 Evans, Dr. David, A Study on the Efficiency of Balston Sterile Air Filters for Producing Commercially Sterile Air, Parker Hannifin, Haverhill MA, Bulletin TI-935T: 2003