bomaksan®
INDUSTRIAL AIR FILTRATION SYSTEMS

METAL DIE CASTING MACHINES

Oil Mist Filter Unit SELECTION GUIDE

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1) What is Oil Mist?

Oil Mist or Oil Smoke (Burnt Oil Smoke, Oil Smoke), is the name given to the vapor / fog released as a result of the evaporation or burning of various coolant and lubricating liquids used in the industry due to contact with a heat source.

The main difference between Oil Mist and Oil Smoke is particle sizes. Oil smoke consists of particles less than 0.1 micron in size, while oil mist consists of particles above 0.1 micron. For this reason, it is important to have clear information about the pollution to be filtered.

What is Oil Mist?

Mist is generally thought of as a small droplet of liquid, but the definition of mist may be different for each sector. For this guide, mist is defined as:

• Liquid particle between 20 micron - 0.1 micron.

What is Oil Smoke?

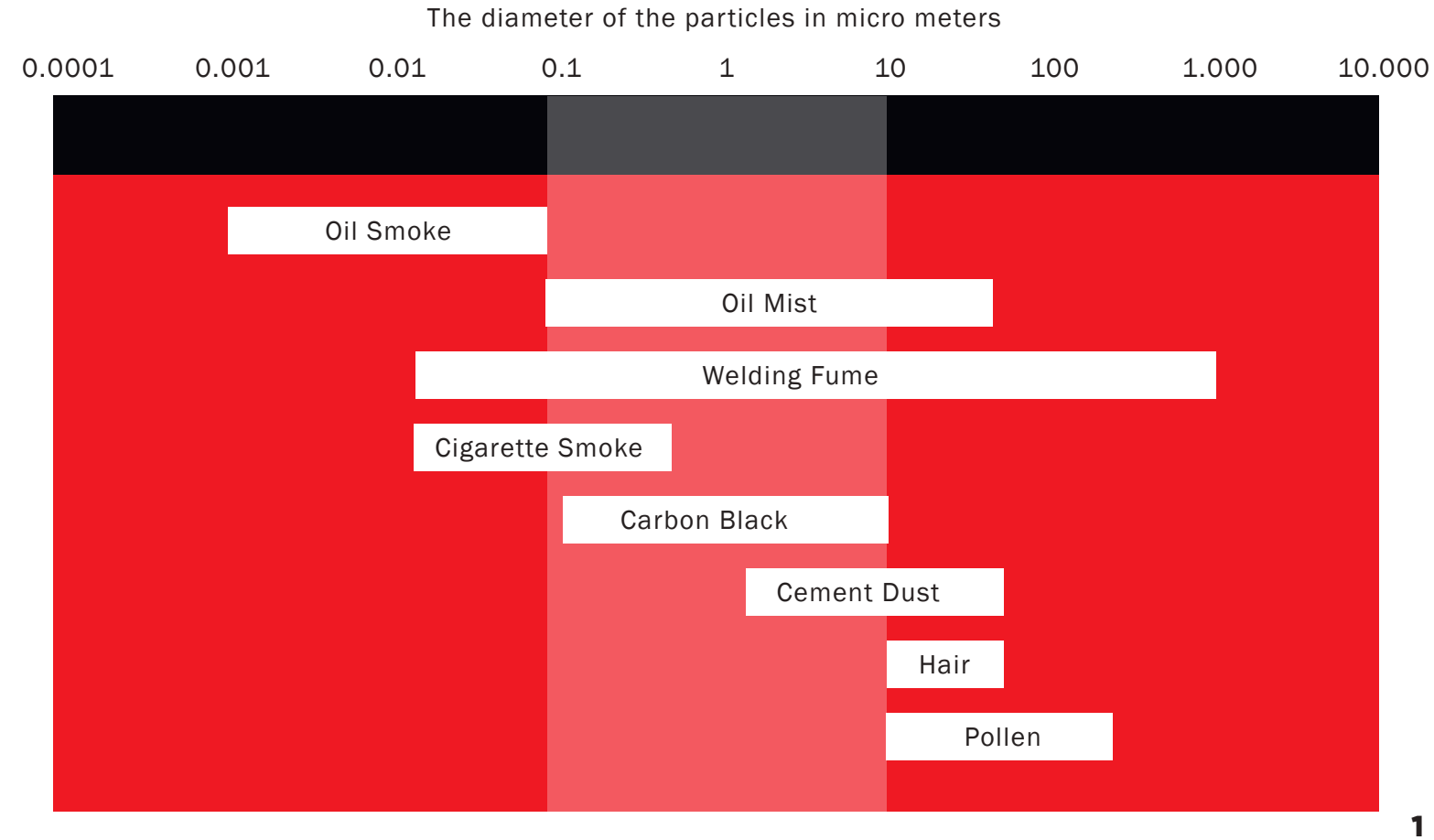
Smoke is often thought of as the gray to black colored air pollution emanating from burning wood, or the pollution you see and smell when someone is smoking. However, smoke is not defined as such in this manual.

Smoke in this guide;

A liquid particle, typically 0.07 to 1 micron in size, condensed from vapor to liquid.

• Thermally generated fog.

• Oily smoke.



1.a. Oil Mist Filter

History of Oil Mist Filters

Since the industrial revolution, coolants, oils and lubricants have been used to improve manufacturing quality, increase production efficiency, and extend tool life.

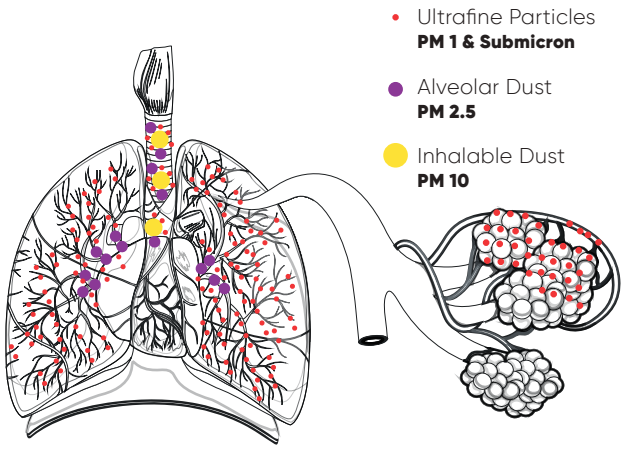
Especially with the growth of the automotive industry and household appliances industry and the transition to mass production to meet the rapidly increasing demands, more efficient production technologies that can tolerate less errors have gained importance. In order to meet this demand, the amount of coolant / lubricant used by the machining industry, the pressure to which these coolant / lubricants are sprayed and the speed of the machining tools have increased. With each increase in the amount of coolant / lubricant used, the spray pressure, and the speed of the machine tools, the particle size of the oil mist / oil smoke decreased while the amount of mist / smoke produced increased. This results in a steady decline in the indoor air quality of manufacturing facilities. So it requires new controls to reduce pollution levels in the air.

For over 50 years, governments, occupational safety and health organizations, and other organizations have studied the risks of exposure to cutting, cooling, and lubricating fluids commonly used in metal cutting and forming processes.

Numerous studies have shown that contact with the skin, ingestion by mouth, and repeated exposure to these materials through inhalation is likely carcinogenic.

As a result of the exposure of these risks, governmental organizations all over the world have determined their exposure limits. Since the late 1990s, OSHA has to reduce the 8-hour exposure standards for metalworking fluids to 1.0 mg / m^3, 0.5 mg / m^3, 0.2 mg / m^3.

Submicron Particles



As a result of the latest researches, it has been confirmed that particles under 1 micron, mix into our blood from the lung bronchi and cause cancer. For this reason, capturing and filtering particles below 1 micron, also called submicron particles, without breathing, is extremely critical for healthy and efficient working environments.

Occupational Disease Risk!

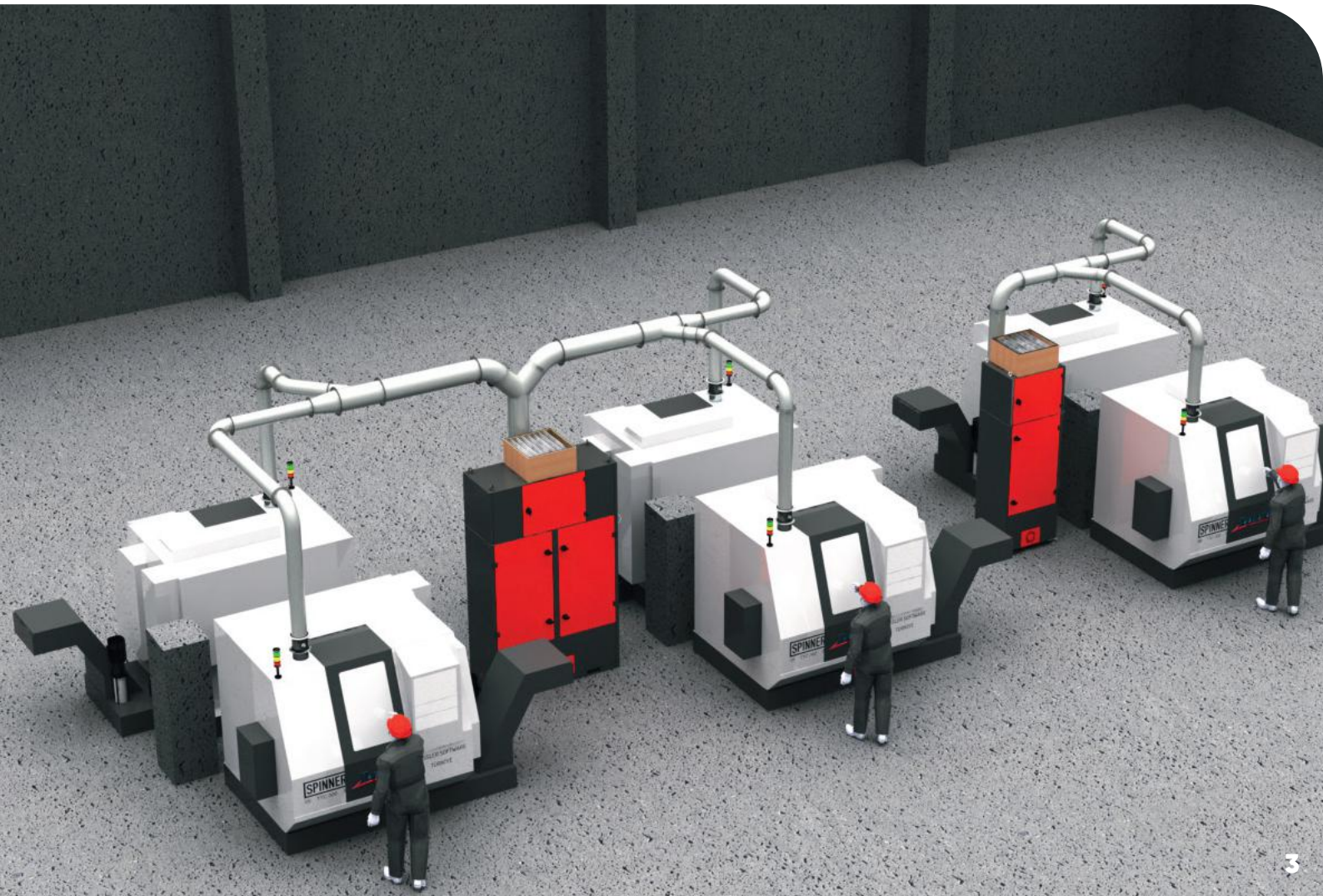
Exposure to mist and smoke from metalworking and shaping processes cause occupational diseases. Occupational disease both takes away the health of the sick employee and puts him in a difficult situation, and also causes the employers to be crushed under heavy compensation burdens.

1.b. Alternative Technologies in Oil Mist Filtration

Filtration of Oil Mist is an extremely difficult task. This is because the contaminated air that is collected and needs to be filtered is the evaporated or burnt state of the cutting, cooling and lubricating fluids used during metalworking and forming processes. This polluted air is moist and sticky. Especially when combined with dry dust, difficulties of filtration increases a lot and special techniques are required. This makes it one of the most difficult filtration tasks. Although the number of companies producing oil mist filtration devices is large, the number of companies specialized in this field is quite low. Selling lots of products is not the same as selling the right products.

For this reason, it is difficult to get accurate information in the oil mist filtration industry. Many companies in the market confuse consumers as they market their moderately efficient technologies as the top technologies available.

The main purpose of this booklet is to **introduce consumers to the technologies** used in the field of oil mist filtration and **which technology should be preferred** in which application in the light of scientific facts. Each of these solutions has advantages and disadvantages. You can get support from Bomaksan Clean Air Experts to choose the most suitable solution for you.

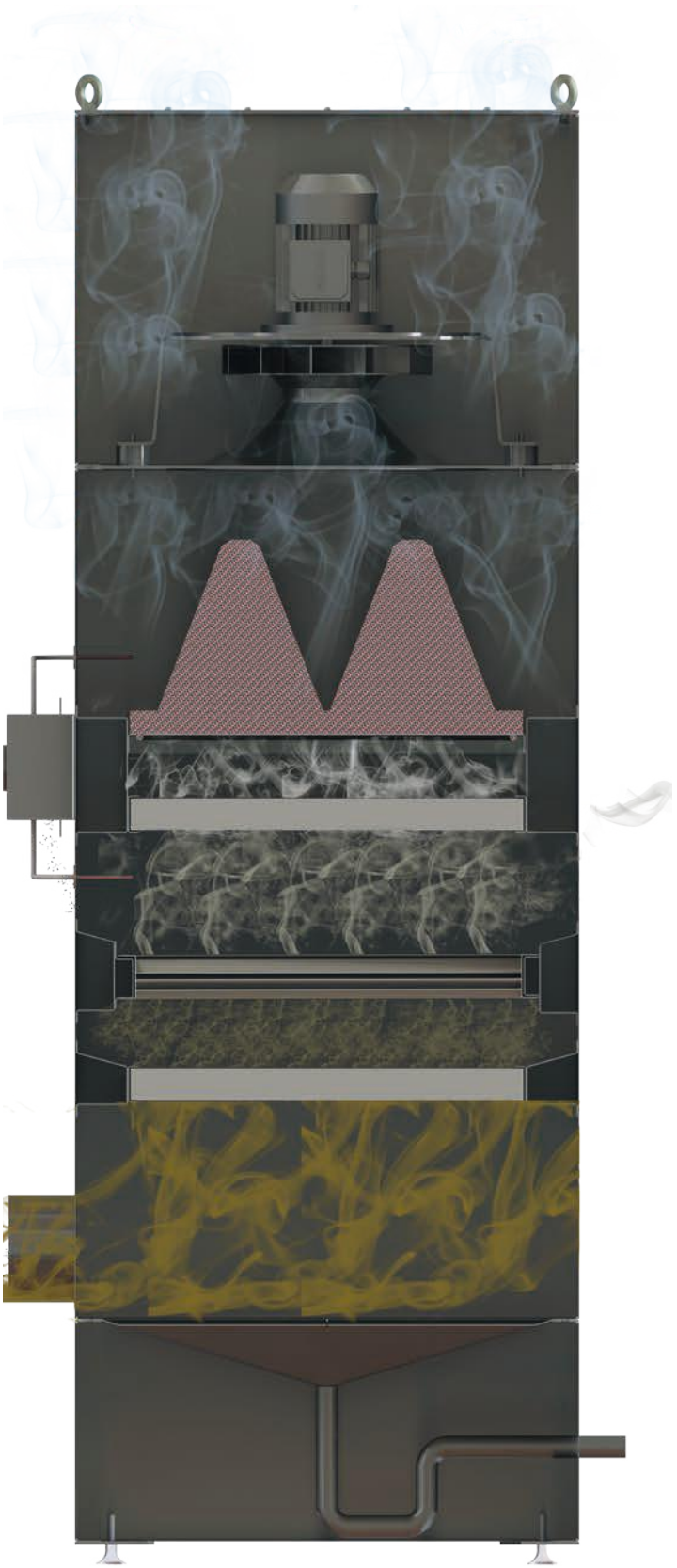


A. Multi Stage Filtration Technology

The most efficient and stable operating systems in Oil Mist Filtration Systems are multi-stage filtration systems. There are different filtration stages up to 3, 4 or 5 stages depending on the technology in filtration systems. In general of these systems;

1. Washable Pre-filter - Mist Condenser
2. Replaceable Pre-Filter - Increasing Main Filter Life
3. Main Filter - long-lasting special filter that captures small oil mist particles
4.. Absolute Filter - HEPA filter (Optional, required when Oil Smoke exist).

Technologies used in main filters are what makes companies different. Many companies in the market use standard air filters in the main filter stage. As a result of this situation, business owners have to stop their production frequently for filter changes.



Advantages;

- High filtration efficiency
- Low maintenance frequency, longer non-stop working
- Long filter life

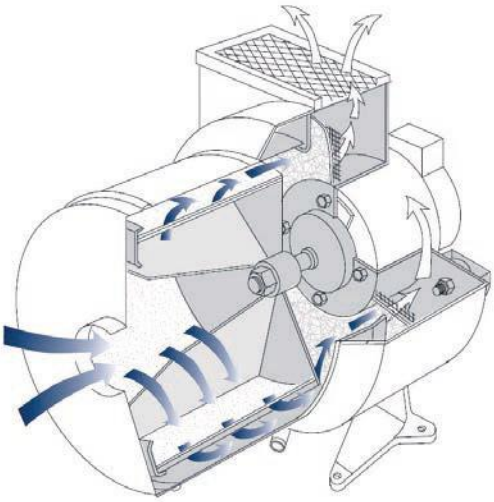
Disadvantages;

- More expensive initial investment cost compared to other technologies

B. Centrifugal Filtration

It is the oldest oil mist filtration technology. The main logic is to filter the collected oil mist by hitting it against the unit walls with the effect of centrifugation in a rapidly rotating drum. When the oil mist adhering to the surface as droplets gradually come together and reach the weight to overcome the gravity force, they filter down the wall into the oil collector.

The biggest handicap of centrifugal filtration is that **they only work with large vapor droplets**. So filtration efficiency is very low. For this reason, HEPA Filters should be used with these products. However, the HEPA Filters used with these units also clog in a very short time and require frequent maintenance.



Since oily and dirty air passes through the drum rotating at high speed, the rotating drum will be out of balance very frequently. Oily and dirty air passing through the drum adheres to the blades of the drum or rotor and starts to disturb the balance in the blades. Such imbalances in very fast rotating systems both pose a risk of work accidents and require frequent maintenance.

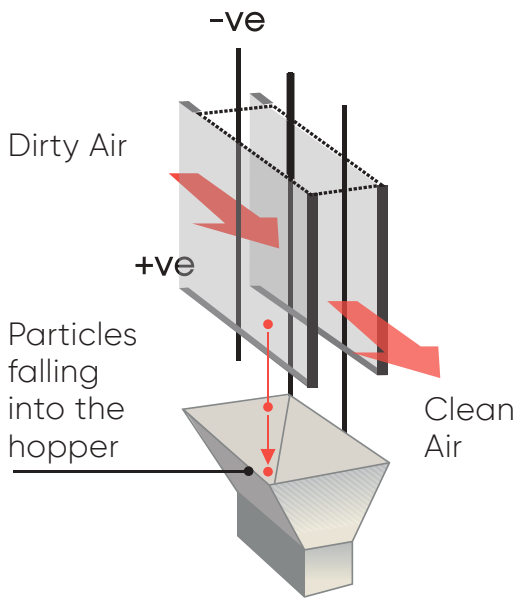
Advantages;

- Low initial investment cost

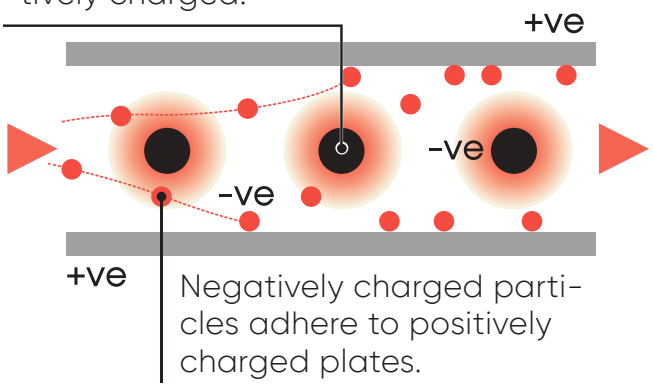
Disadvantages;

- Frequent downtime for maintenance
- Frequent maintenance need
- Expensive HEPA Filters need to be changed very frequently. (High Total Cost of Ownership)
- The drum needs to be re-balanced pretty frequently. (High Total Cost of Ownership)

ELECTROSTATIC FILTERS



CROSS SECTION AREA IMAGE



C. Electrostatic Filters

The working principle of electrostatic filters is about electrically charging the dirty particles passing through the filter unit as + and - and catching them in the plates inside. The filter efficiency of electrostatic filters varies according to the power used.

The biggest challenge for electrostatic filters is that they require constant cleaning. This situation turns into a nightmare for many maintainers and is not used over time. However, electrostatic filters with automatic cleaning systems are life-saving solutions for many production processes. The biggest problem of these systems is that the investment and running costs are very high.

Advantages;

- Working in harsh conditions when appropriate choices are made
- Suitable to work with Oil Smoke (Burnt Oil Mist)
- Low maintenance frequency in automatic washing systems
- No filter replacement costs in automatic washing systems

Disadvantages;

- The initial investment cost is high.
- The frequency of maintenance is high in systems with manual washing. A maintenance team should constantly wash the batteries on a weekly basis.

2) Filtration in Die Casting Machines

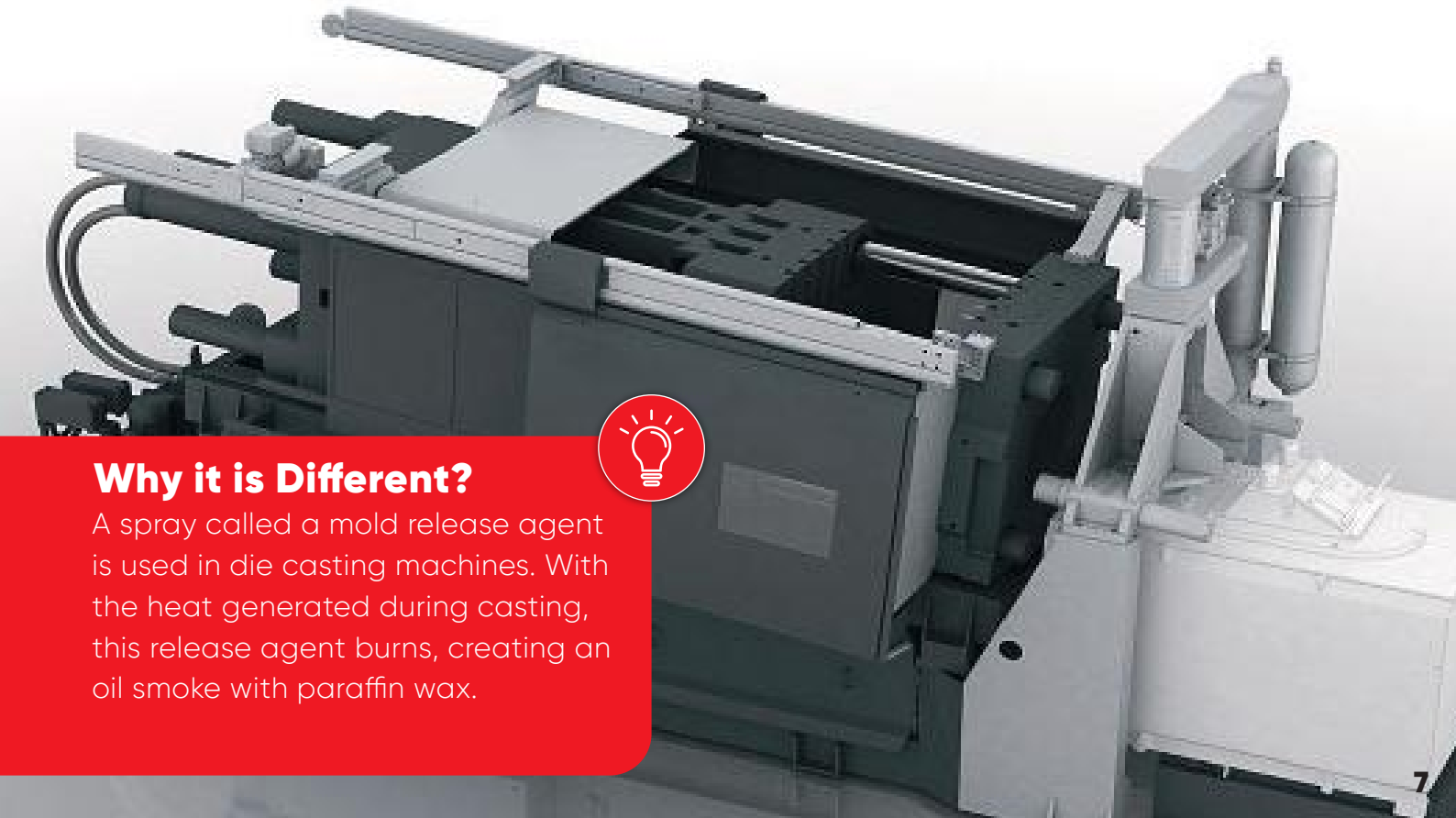
Casting materials are formed by pouring molten metal into a mold and leaving that mold to cool. Parts produced in die casting machines need to be removed quickly from the mold. For this reason, a water-wax mixture mold release agent is used in the die casting machines. This release agent is sprayed into the mold between each casting operation and creates a barrier between the casting material and the mold so that the casting piece is easily removed from the mold.

The main ingredients of this mold release agent are paraffin wax and water.

When the mold release agent encounters high temperatures, a smoke is released, which is mostly wax and water vapor. Of course, some metal fumes are released when molten metal is poured into molds.

The dirty air released from this process is one of the most difficult processes to filter.

The reason for this is that the released wax and water vapor mix in the air quickly turn into a muddy structure. When such sludge-like impurities adhere to the filters, they quickly clog them. **Although dry type filter units can be used in these processes, it is not highly recommended**. This is because paraffin wax immediately clogs the filter surfaces. However, it can be used with many washable metal pre-separators, but in this case, these separators should be washed frequently. This is not a very applicable method for many processes.



Why it is Different?

A spray called a mold release agent is used in die casting machines. With the heat generated during casting, this release agent burns, creating an oil smoke with paraffin wax.

The most accurate filtration method for paraffin wax and water vapor mixture pollution released from aluminum, Zamak, Zinc and magnesium press injection (die casting) machines is **electrostatic filter units with automatic washing**. The most important advantage of these units is that their maintenance frequency is low and they do not stop the production process frequently. Therefore, the preference of professional businesses is electrostatic filter units with automatic washing.

The following points should be taken into account when selecting the extraction system for die casting machines;

A. Extraction Hood

a. Oil mist extraction in die casting machines such as Aluminum Press Injection should be done by automatic controlled and movable hoods. In this way, air pollution can be trapped in this hood and do not disturb other working areas.

B. Ducting Design

a. Sealing is the most important challenge in oil mist piping. If the correct type of sealing elements are not used, leaks will occur at the joints of the pipes.

b. In-channel transport speed should be at least 20 m / sec. Otherwise, oil mist will settle in the pipe and accumulate. This situation causes serious security risks, especially fire.

c. Dry type, dust, smoke or gas should not be conveyed in the same suction line. Otherwise, the oil mist will become muddy and cause the filters to clog quickly

d. Piping design should be done by a competent firm.

C. Oil Mist Filter Unit

a. The filter unit to be used in die casting benches should be electrostatic filters with an automatic washing system.

i. The most important reason for this is that paraffin, paraffin wax and

water vapor mix in the resulting smoke to form a muddy structure and this quickly clogs the filters.

ii. Electrostatic filter units without automatic washing feature should be cleaned daily or weekly, depending on the frequency of use. This does not serve the purpose of die casting machines purchased for mass production.

b. When choosing a radial fan, fans which can provide sufficient air flow while overcoming the pressure of the line and the unit should be preferred.

c. If the Filter Unit will be located indoors;

i. Sound pressure level should be max 80 dB (A). If this is not possible, the unit should be located outside.

ii. HEPA filters should be preferred as the last stage filter when necessary, depending on the emission level released from the filter unit.

d. Electric panel;

i. Panels with appropriate power for the electric motor should be preferred.

ii. The panel must be manufactured in accordance with the machine safety directives and must have the necessary electrical equipment.

iii. If remote operation or operation is requested from the process, the electrical panel must be designed and manufactured accordingly.

Automatic Washing System

Units with automatic washing system should be preferred, as there is a need for continuous washing to clean the pollution arising in the die casting process.

Bomaksan offers these systems to its customers with its partners.

3) How to Compare Offers?

Since oil mist extraction and filtration systems require a technical and very special purchasing process, it is very difficult to compare apple-apple. Our goal is to help our customers choose the best solution for them while investing.

The first thing you need to do when choosing an oil mist extraction and filtration system is to have each company fill in the "Oil mist extraction and filtration system offer collection table" for the offers you have received. Descriptions of the cells in this table are given in detail later in this guide.

3.a. What is Air Flow?

Different terms such as Suction Flow, Extraction Capacity can be used. Extraction capacity is the name given to the air flow that the fan can extract at a certain pressure value. What is critical here is to specify the value given by the extraction flow at the pressure to be used. The flow rate in some technical catalogs is specified as the maximum flow rate that the fan can deliver, which is quite misleading. Because the fan will never reach that value in real conditions.

The most accurate approach in this matter is to determine the air flow delivered by the fan at the calculated fan pressure, based on the fan performance curve.

3.b. What is Fan Pressure?

Fan total pressure is the name given to the total pressure loss that the fan can overcome. In suction lines;

- Extraction Hood
- Dust / Fume transport channels (Elbows etc.)
- Pre-Seperators (Cyclone etc.)
- Filter Unit
- Duct between Filter and Fan
- Silencer
- Chimney / Stack
- Accessories such as Jet-Cap

There are areas that resist suction. Each of these areas are areas that resist suction or in other words cause pressure loss. The total pressure loss created by these areas creates the total pressure that the fan you will buy has to be overcome. While choosing the fan, it should be noted that the fan reaches the requested flow at this total pressure.

Caution When Evaluating the Fan!

When examining the technical features of the fans, the point to be considered is that the required flow rate can be obtained at the required pressure. Some manufacturers give their maximum fan capacity information, not the capacity the fan receive at the required pressure. However, this value has no meaning since it will never deliver this maximum air flow in your process. Therefore, it is useful to examine the fan capacity and motor power together.

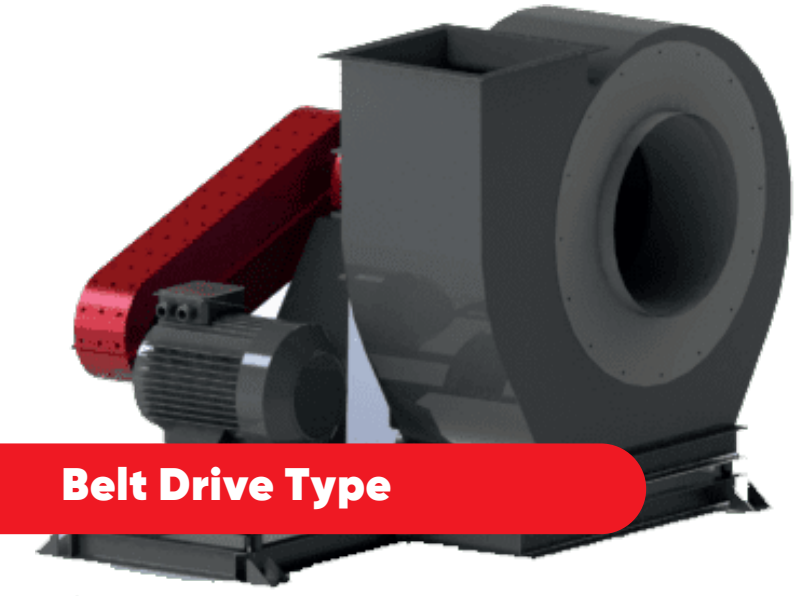
3.c. What is Fan Drive Type?

Fan drive type specifies how the motor drives the rotor in the used fan. Generally 3 types of drive type are used in radial fans;

- Direct Drive: These are the fans that the motor drives the rotor directly through a shaft.
- Direct Coupled: These are the fans that the motor drives the rotor through a coupling shaft.
- Belt Drive: These are the fans that the motor drives the rotor with a belt pulley.

Which One is Better?

It will not be correct to say one is better than another. Any of them can be the right choice, depending on the needs of the process.



Belt Drive Type

3.d. What is Shaft Power?

Shaft power is the total power required to rotate the shaft according to the extraction capacity of the fan and the total fan pressure. Shaft power calculation is a mathematical calculation. The formula is given below;

Shaft Power Calculation

$P = (P(t) \times Q) / (102 \times \eta(m) \times \eta(mech.) \times 3.600)$

P : Shaft Power (kW)
P(t) : Fan Total Pressure (mmSS)
Q : Air Flow (m^3/h)
$\eta(m)$: Motor Efficiency
$\eta(mc)$: Mechanical Efficiency

The critical factor here is fan efficiency. Fan efficiency can never be 100% and general acceptance;

- Motor Efficiency: 85% (Standard acceptance, may differs according to the IE class and power of the motor)
- Mechanical Efficiency;
  - Direct Drive : %90-95 efficiency
  - Direct Coupling : %80-85 eff.
  - Belt Drive: %80-85 eff.

Example;

Q = 4.000 m^3/h
P(t) = 275 mmWG
Fan Drive = Direct Drive

Shaft Power:
= (4.000 / (102*0,85*0,90*3600))*275
= 3,92 kW

Shaft power calculation is critical in motor selection. The motor to be used should be selected at least 5% higher than the calculated shaft power.

3.e. What is Motor Power?

Motor power is the motor power of the fan in the compact filter unit you will purchase. As mentioned previously , it should be selected above the shaft power. It is expressed in HP in the imperial system and in kW in the metric system.

Motor power is one of the most important parameters in an oil mist filtration system, because motor power directly affects extraction performance. Mathematically, it is not possible for 2 fans with different motor powers to show the same performance, unless they are using different filtration technologies and one has terrible filter unit design.

Unfortunatelly, some manufacturers' design their filter unit so small that the pressure loss of the filter unit is 3x higher than it should be. In such cases, 2 fans with different motor can deliver same air flows.

In such cases, even the filter unit with bigger motor seems to have higher extraction capacity, well they don't because of the huge pressure loss of the filter unit.

Attention When Comparing Filter Units!

Some manufacturers designs their oil mist filter unit so small that the pressure loss of the filter unit becomes 3x higher than it should be. In such cases, 2 fans with different motor can deliver same extraction performance.

3.f. What is Filtration Technology?

Filtration technology is the area where the technology is used in oil mist suction and filtration. It should be noted that the most common technologies in Oil Mist Filtration systems have to reach the demanded air flow at total fan pressure.

A. Centrifugal Filtration

- This technology is one of the oldest technologies on the market.
- On the basis of the technology, there is condensation and filtration by hitting the extracted oil mist particles against the walls of the filter with the effect of centrifuge.
- **Advantages:**
  - It has a small compact structure.
- **Disadvantages:**
  - The drum /impeller which makes centrifugal effects might be out of balance very frequently. This means high total cost of ownership.
  - Since the filter efficiency is insufficient for today's requirement, HEPA filter will be required at the end. In this case, expensive HEPA filters need to be changed frequently.
  - It can only be used in processes with large droplets.

B. Multi-Stage Filtration Technology

o It is the most reliable technology in oil mist applications.

o The basis of the technology is the filtering of the extracted oil mist particles and oil smoke through a 3 or 4 stage filter, respectively.

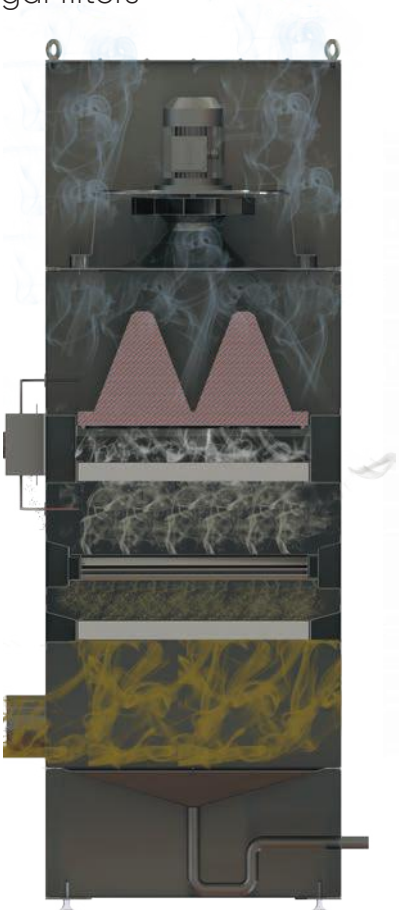
o Each stage provide different type of filtration and thus, at each stage a certain amount of pollution is filtered. The main purpose is to extend the life of expensive end-stage filters, thereby providing lower maintenance costs.

o **Advantages:**

- Low total cost of ownership due to long filter life
- Less frequent maintenance
- Option to be connected to many CNC Centers at the same time
- Suitable and energy efficient use even in high capacity applications
- It is suitable for mass production CNC Lathe & Milling machines.

o **Disadvantages;**

- Takes up more space than centrifugal filters



C. Electrostatic Filtration Technology

o At the heart of the technology are plates that electrically charge the particles passing through them. Negatively charged particles adhere to positively charged plates.

o Electrostatic Filtration Technology can be divided into 2 types; automatic washing and manual washing systems. These 2 types needs to be evaluated as 2 different technologies.

o **Advantages of Auto Cleaning:**

- Containing paraffin wax can even retain oil vapor and heat.
- Very low maintenance cost
- There is no maintenance work such as filter replacement and cleaning.
- It is suitable for mass production machines.

o **Disadvantages of Auto Cleaning:**

- High initial investment cost

o **Advantages of Manual Cleaning:**

- No filter replacement cost
- Low initial investment cost

o **Disadvantages of Manual Cleaning:**

- High maintenance cost
- Require weekly high duty maintenance.
- Not suitable for mass production CNC Centers

Manuel Cleaning Type

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