Elastocon®

Some reflections about requirements on (ageing) ovens

This is a short introduction to some key factors that is important when you choose a new oven for your laboratory, especially if you are going to age polymeric materials.

On the market you can find a huge amount of different type of ovens. All these different types can have different descriptions, such as Ageing Oven, Laboratory Oven, Drying Oven, Heating Oven/Cabinet, Geer Type Oven etc.

Unfortunately, some of these descriptions are sometimes used a little carelessly. With this text I hope to help you clear some of the differences between some different type of ovens, and why they shall never be mistaken for another type of oven. The main part of the text will be about the high precision ageing ovens and the specifications for them.

Each type of oven has its advantages for its respectively supposed usage BUT will not be suitable for another usage. Therefore, it is very important that you know the differences, and can specify what your actual needs are when you should choose the correct oven for your testing. If not, you might end up with an oven that is not suitable for your usage area.

Geer Type Oven
We'll start with some few words about the so-called Geer Type (Ageing) Oven, this is a description term often used by different manufacturers. The problem with this, is that there is no international standardization of the expression Geer Type Oven.

Which means that each manufacturer can call their oven for Geer Type Oven and you end up comparing different types of ovens with sometimes big variations in the specifications and with the best suitable application for the oven. Just like if you would compare a grape with a cucumber, similar but not the same.

Other descriptions of ovens
Heating cabinet, heating oven, drying oven and laboratory ovens are another big area among the ovens. All of these are nice products, often not too expensive and therefore a primary choice, especially among purchasers.

Important to remember about these are to check for which usage area they will work the best. These types of ovens will most often not be a good choice as an ageing oven for polymeric material. They will cause faulty results.

Ageing Ovens
When it comes to the expression ageing oven, it is a standardized expression with very well specified requirements for different features. This to certify the function and therefore also the reproducibility (also between different laboratories), and natural the reliability of the results after using this type of ovens.

It is a proven fact that polymer heat ageing tests give poor reproducibility if the wrong type of oven is used. And from studies made through several years (ITP studies) the international standardization committee could develop the requirements for suitable ageing ovens for polymeric materials that certifies the reliability, reproducibility and repeatability for ageing tests. Requirements found in standards like ISO 188 and technically equivalent standards.

The results of these studies confirmed the importance of the control of;

- Temperature variations in time
- Temperature variations in space (inside the oven)
- Air speed inside the oven
- Air exchange rate and naturally also the presence of the same

It is a fact that even a small temperature offset of 1 °C during ageing, can correspond to about 10 % difference in test time.
Which means that you will have problem to predict e.g. the life time of your material already when you have a small variation in temperature.

Controlled air speed (without a fan inside the oven) and air exchange rate are important to ventilate off the residues from the material that is released to the air inside the oven, as well as to make sure that the oxygen content in the air around the samples remains constant, and as close as possible to the real environment your material is used in, often common air.

Differences between ovens
A comparison of the vital parameters for proper ageing of polymer materials between two different types of common ovens in the market would look like this:

Requirement	**High precision ageing ovens**	**Laboratory ovens**
Temperature accuracy in time	Yes, high requirements	Yes
Temperature accuracy in space	Yes	No
Specified air speed	Yes	No
Specified air direction	Yes	No
Specified air exchange rate	Yes	No
Specified extra temperature sensor	Yes	No

So, as you can see, when you need a new oven to your laboratory/company you should start with considering what the usage of it will be, which standards you are going to use, not forgetting which test method from each standard since they could vary a lot when it comes to the oven

requirements. After this you are ready to search for the correct type of oven for your specified needs.

They all have their advantages, IF they are used for the correct purpose and not are mistaken for being something they are not.

Make sure that you understand the specifications, and that you know which area inside the oven that fulfills the specifications. Sometimes it is only a small space in the middle of the oven that will fulfill the ageing standard requirements, and this means that you cannot use the whole ovens inner space, which seems like a waste of money and space.

Unfortunately, there isn't an oven that can meet all your needs in the market, you need different type of ovens for different type of testing.
Just as well as you use a thin cool jacket in the warm summer and a thicker warmer jacket during the winter time.

But if you start to specify your needs thoroughly and look only to ovens that will fulfill those requirements you will have the best suitable oven for your needs.

The text is written by Anna Anderzén, Sales Manager, Export Area

Cell ageing oven or Cabinet ageing oven?

As you hopefully already know really well, the first step when you choose a new oven to your laboratory is to make sure that you choose the correct type of oven for the standards and test methods you are going to use. When you have established that comes the next decision. *Should I choose a cabinet or cell oven?*

Here are some points that helps you see the differences between them. Some of these points are only valid for Elastocon ovens, other points can be adapted to other manufacturers ovens as well.

	Cell Ageing Oven	**Cabinet Ageing Oven**
		
Inner volume	Smaller, 100*300 mm	Bigger, from 50 litre up to 120 litres
Suitable for samples, e.g. dog bones	Yes	Yes
Suitable for products	No	Yes
Temperature accuracy in the whole inner space	Yes	Yes
Air speed	Fulfils standard requirements	Fulfils standard requirements
Air exchanges per hour	3-20 changes/hour, adjustable with air flow meter, with individual control for each cell.	3-200 changes/hour, adjustable with air flow meter or fixed during production depending on model.
Numbers of different temperatures	1-6 (Each cell can have their own individual temperature and therefore works as separately ovens)	1
Numbers of different materials that can be aged simultaneous	1 – 6	1 (You shouldn't have different materials in the same space, they might interfere with each other)
Option for turbulent air flow	Yes, with an additional air stirrer in the bottom of the cells	Yes, our EB 26 has a carousel that enables turbulent air flow and higher air speed

Information about ageing of polymers

Durability testing

The durability of polymer materials is affected by a number of environmental factors in combination with the mechanical stresses that are caused by the use of the product itself.

Influencing factors
It was well known from an early stage in the development of polymer materials that factors like heat, sunlight, oxygen in air and humidity in general accelerate the degradation of rubber. Mechanical loads, erosion, impurities, micro-organisms and other special influences occur depending on the application of the material.

Accelerated ageing
Normally there is no time to wait for a test under real conditions. It could in fact take decades to get the natural results.

Accelerated ageing is therefore used. This means the factors that cause natural ageing are reinforced.
This could take place both outdoors – in a desert or tropical rain forest – and indoors in ovens, climate chambers or weather simulators.

Unfortunately, this is often done with no proper critical analysis. The ageing process is accelerated far too much, and the material is literally grilled. The accelerating ageing process then becomes completely different from the natural process. The result is incorrect predictions of the actual durability.

The philosophy of ageing processes
The functional environment must first be carefully analyzed, so that the most important degradation factors in each application are identified. Using the available knowledge, it is then determined how far the acceleration can be taken. The available knowledge and facts are seldom sufficient in order to determine the maximum permissible acceleration or to translate the results into an exact number of years under real conditions.

The acceleration has therefore to be carried out in moderation and using rules of thumb.

If durability testing is to be carried out seriously, long testing times (a year is not uncommon) must be expected.

It is surely always better to wait a long time for a more correct result than to get an incorrect one quickly.

What to remember about the ageing process
In all ageing processes it is especially important to keep a constant temperature and in certain cases a constant relative humidity in air.
This is due to that the speed of a chemical reaction is roughly doubled for a temperature increase of 10 °C – and ageing is in most cases a chemical reaction.

Normally, the highest deviation of ±1 °C is allowed. In all ageing, and especially for long testing times (up to a year and more can occur), it is extremely important to be sure, that the temperature has been maintained within the permitted tolerance during the whole testing procedure.

Another important factor is the flow of air. During the ageing process, the oxygen in the air is used up and degradation products are formed. In order to make the testing reproducible, the oxygen concentration must be kept at a constant level, and the degradation products ventilated off.

In order to meet these requirements, the air must be changed between 3 and 10 times per hour (other specifications could also be valid). The device must therefore be equipped with an air supply and flow meters. The air speed must also be low, otherwise the oxidation rate can increase, and plasticizers and antioxidants be ventilated off.

The text is written by Anna Anderzén, Sales Manager, Export Area

Ageing polymer
When rubber materials ages with time, this normally show it in increased stiffness and reduced elongation. Easily oxidized materials, as for example natural rubber, become softer for longer ageing times.
When a rubber material ages, among other things, the following reactions take place:

a) **Oxidative degradation**,
caused by oxygen, which creates breaks in the polymer chain.

b) **Thermal degradation**,
caused by thermal movements in the polymer chains, which cause breaks in the polymer chains.

c) **Additional cross-linking**,
caused by the remains of curing agents. In curing systems with high sulphur content, polysulphide and disulphide links can break up and form new crosslinks of the di- and nonosulphide type.

The changes in a polymer material when ageing can be examined by testing for several properties. The most common way to test the effect of ageing on a rubber material is to do a tensile test and measure the change in hardness. The total ageing effects are most apparent in the decrease in elongation at break. The additional cross-linking is most apparent in the increase in hardness and increase in tensile strength.

Some examples of Elastocon high precision ageing ovens

EB 20, cell ageing oven with 6 cells

EB 01-II, cell ageing oven with 4 cells

EB 28, test tube ageing oven with 4 different temperatures and 24 test tubes

EB 04II-60, cabinet ageing oven with window (also available in 120 l)

EB 10-II-60, cabinet ageing oven (also available in 120 l)

EB 26, cabinet ageing oven with carousel

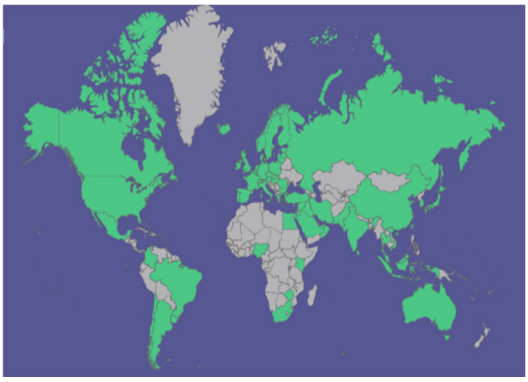
The text is written by Anna Anderzén, Sales Manager, Export Area

If you have any questions or need any help – please contact us at Elastocon, we will be happy to help you!

Who are Elastocon?
Elastocon develops, manufactures and sell instruments around the world for testing or rubber and plastic materials. We offer instruments for existing test methods and develops instruments for new test methods. Our objective is to offer instruments with high precision which gives accurate results.

We offer:

- Instruments
- Calibration
- Testing Services



Green colour shows countries where you can find our customers

Few History Highlights:
1987 - Elastocon was founded by Göran Spetz who worked at the Swedish National Testing Institute at that time. Göran has also been active within the international standardization committee since 1978.
1993 – Calibration service started
1999 – ISO 9001 certification
2000 – ISO 17025 accredited for calibration
2011 – We moved to our new premises at the other side of Borås
2015 – Martin (Görans son) succeeds as Managing Director for Elastocon
2018 – ISO 17025 accredited for contract testing in our laboratory

Contact us!

Website; https://www.elastocon.com/

General email; info@elastocon.se

Martin Spetz
Managing director
Martin.spetz@elastocon.se

Göran Spetz
Manager Marketing and Sales
Goran.spetz@elastocon.se

Anna Anderzén
Sales Manager, Export Area
Anna.anderzen@elastocon.se

Ann-Cathrine Magnå
Sales Manager, Nordic Area
Ann-cathrine.magna@elastocon.se

The text is written by Anna Anderzén, Sales Manager, Export Area