English text

Shot 1

Czech and Murano glass through the eyes of the glass fussing technologist.

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Shot 2

In the chart, we can see typical oxide composition of crystal glass produced in Murano as well as in typical Czech production. The composition of melted glass is often the company´s secret and is very carefully protected. The composition of glass that is labelled MURANO comes from the study of many sources, which describe the chemical containments of glass melted in Murano. The containments of AJETO glass is a typical Czech sodium-potassium crystal. In the nineties, we worked with glass with these compositions in Ajeto glassworks in Lindava on the optimization. The glass labelled SVACHA is the result of diploma thesis, which explored the optimization of the containment of Czech crystal sodium-potassium glass. The last two columns - MIN and MAX are certain boundary ranges of each oxide in common crystal glass.

Shot 3

The influence of SiO2 on the basic glass properties

Silica (silicon dioxide) – SiO2 is a basic component of glass. In the glass, it is mostly in a form of glass sand, which is a necessary and significant mineral source that the glassmakers have been adding to the glass for centuries. In Murano, it started with the sand that was refined from sea lagoons. In Bohemia, there have been used mineral deposits of sandstone (deposits of tertiary seas that were located in the are of Bohemia). The lower the content of SiO2 in the composition, the lower melting temperature of the glass. That is the reason, why in earlier days, there was a problem to achieve high melting temperatures during melting of glass (today it is about 1450°C). The original Murano glass was with low SiO2 content, in order to achieve the lowest melting temperature possible. In the case of Murano glass, the temperature is around 1350°C.

Shot 4

The basic glass structure - only SiO2 - Crystal lattice is not arranged - that is a basic quality of glass

Here you can see a basic structure SiO2 in the glass. An important finding is that the lattice does not have a crystal regularity and that gives one of the basic properties to glass - chaos and disorder (unlike for example metals). From a thermodynamic site, glass is a “supercooled” liquid. It is not a typical solid material. This chaos of the basic pseudocrystalic lattice of the glass is the basis of all irregularities and unpredictability in the glass processing. We could say, that glass is 90% countable and 10% is a god will (and that is the disordered basic structure of SiO2). This 10 % is also, what makes glass beautiful material and what makes us excited.

Shot 5

The content of monovalent oxides in monitored glass compositions.

Another significant chemical component of glass is the content of monovalent oxides in the final composition of glass. The most common and traditional monovalent elements that form oxides, entering the glass structure, are sodium and potassium. Both these elements are traditional and

historic, modern glass also consists of oxides Li2O (Lithium), but that is used only in case of special glass, due to the price. It is obvious from the chart, that the sum of monovalent oxides (sodium and potassium) is in the case of Murano glass higher than the sum of these oxides in Czech composition. The resulting effect on the glass properties is that the Murano glass melts at lower temperatures than Czech glass and has lower viscosity and longer processing interval than Czech glass.

Shot 6

Back to school and chemistry class …

The first group of monovalent elements, in our case sodium Na and potassium, follow each other in periodic system. That means, that both elements bring similar properties to glass. However, they act just a little bit different in the glass structure. The atom of sodium is smaller than the atom of potassium, and we could say that sodium influences the glass less than potassium by half. In the chart, we can see that the smallest atom of Lithium belongs to the same group as sodium and potassium. That is some kind of "improvement" of the glass properties. We are going to hear about Lithium in the future, especially in the area of lithium electric cells, used for energy storage. An that is the future for the area of new "super glass". Unfortunately, these are not used for lighting.

Shot 7

The input of monovalent elements in the structure of glass

In this shot, you can see the influence of monovalent ion Na into the glass structure. Sodium – Na settles into the interspaces of lattice SiO2 and then starts to form links with O2 (from the structure of SiO2). Because subsequently, K – potassium has a bigger atom, therefore fills the lattice SiO2 more than Na – Sodium and its influence and linkage is significantly greater than in the case of Sodium.

Shot 8

The high content of Na20 in Murano glass

The first and very important difference between Murano and glass from Nový Bor is the sodium oxide content. The Italian composition moves in the upper limit of general sodium oxide composition in the glass. On the other hand, the glass from Nový Bor has quite small sodium oxide content. We are going to focus on the influence of sodium oxide on glass. The higher sodium oxide content prolongs the interval of glass processing, decreases its viscosity at that temperature and therefore, it is possible to shape glass at lower temperatures. On the other side, the higher sodium oxide content significantly decreases the hydrolytic resistance of glass. Glass with such high sodium oxide content is susceptible to corrosion when in contact with water. However, the moderate aluminium oxide content stabilizes glass corrosion resistance. The main influence of high sodium oxide content on the "length" of glass, is the workability when working with the pipe. Murano glass workability has a long interval, the glassmaker has enough time to process the glass and can also do filigree parts.

Shot 9

Influence of Na2O on glass properties

The term "long glass", means that glassmaker can produce more products because it talks longer before the glass is ready on the pipe.

Shot 10

The high content of K2O in Czech crystals

Potassium has a bigger atom than sodium Na, therefore it has a much greater influence on the bond strength in glass. Glasses with high potassium content K – K2O are intended for fast processing on the pipe – the glassmaker produces more product. They are primarily intended for next refining – cutting and grinding - that is characteristic for Czech crystal glass.

Shot 11

The biggest difference between Murano and Czech crystal

Apparently, the biggest difference and influence in the composition of Murano and Czech crystal glass - potassium - it strengthens glass structure – makes glass "shorter" and "harder". Czech glassmaker produces more products because glass solidifies much faster than in the case of Murano glass. Moreover, you can cut Czech crystal. The high content of K2O that can be found in SVACHA glass is due to the influence on other, mostly colour glass.

Shot 12

The influence of bivalent elements on the glass properties - Ca and Mg

Both Calcium Ca and Magnesium Mg stabilize the glass structure. Both elements have a great influence on glass chemical stability. In addition, magnesium decreases crystallization properties of glass, which is very important in the case of "long" Murano glass. Supplementing the basic structure with magnesium is in the case of Murano glass caused by the sea. There can be found a great amount of magnesium in the sea, especially in the seaweed. Today, glass scientists use MgO – magnesium oxide more and more, due to its subsidy properties. We in Bohemia do not have seaweed and it is not used in Czech crystals. However, if I could design a perfect crystal "super crystal", I would definitely add MgO, at least a small amount – 2 – 3%

Shot 13

Back to school – now the second group - Mg and Ca

We are going back to the periodic system. Again we see similar properties in case of Mg – Magnesium and Ca – Calcium – traditional components of glass. The periodic system of elements is an amazing logic, and we can deduce a great number of properties and influences. Understanding of Mendeleev periodic table is the basis for understanding chemistry. For us chemists, it is some kind of primary law, from which we can read all that is related to inorganic materials. For the next time, we could discuss maybe the influence of periodic system on colour of glass.

Shot 14

Here, we can see a characteristic viscosity curve showing the processing behaviour of common glass. There are several important parts on the curve. The area of glass clarification - the highest temperature of a chemical process, temperature 1450°C. The area of glass shaping - on glass pipe it is between 1170°C - 650°C. In this interval, glassmaker can process the glass. If the glass is cold, he must heat the glass to the interval of temperature so it is possible to process it again. The temperatures under 600°C leads to the cooling of the product and to final processing techniques.

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On this viscosity curve, we can find the most important intervals for working with glass. Melting takes place at high temperatures, which are at common glass 1450°C. The shaping of glass by different techniques requires 1200°C to 610°C and cooling of the glass, which needs temperature in the area 520° to 430°C. Again, this applies to common glass, not special glass. I would be really happy if you could remember this curve because it is a curve of life of glass processing.

Shot 16

In this slide, we can see an example of a special glass. These are pure optical glasses. The chart of their viscosity shows how different temperatures belong to the same viscosity – glass fluidity. For example the upper cooling temperature is in the case of Corning glass 730°, Schott glass D263 has only 560°C. The same property of different glass at different temperatures.

Shot 17

And this is the final chart of this lecture. The comparison of the viscosity curve of Murano and Czech crystal glass. Due to higher Na2O content in Murano glass, its viscosity curve is flatter, the interval of glass processing is longer (1200°C - 600°C), while Czech crystal (1200°C - 700°C). Czech glassmaker has less time to process the glass than Italian and produces more products at the same time. The glass cools faster. Glassmakers call the glass “shorter”. And that is the biggest difference between Murano glass and Czech crystal.

Thank you for your attention
Do you have any questions?