Chapter 4 Notes Part 2: Analysis of Glass

Forensic Analysis of Glass
- Glass that is broken and shattered into fragments and minute particles during the commission of a crime can be used to place a suspect at the crime scene.
- Chips of broken glass from a window may lodge in a suspect's shoes or garments.
- Particles of headlight glass found at the scene of a hit and run accident may confirm the identity of a suspect vehicle.
- All of these possibilities require the comparison of glass fragments found on a suspect (person or vehicle) with shattered glass remaining at a crime scene.

Composition of Glass
- Glass is a hard, brittle, amorphous substance composed of sand (silicon oxides) mixed with various metal oxides.
- Glass is formed by mixing sand with metal oxides, melting them at high temperatures, and then cooling the mixture to a rigid condition WITHOUT crystallization.
- Sodium carbonate is usually added to the mixture to lower the melting point and make it easier to work with.
- Lime (calcium oxide) is another essential ingredient, which is added to prevent the glass from dissolving in water.
- One of the most common types of glass analyzed by forensic scientists is float glass - glass used for windows.
- This type of glass is cooled on top of a bath of molten tin, which produces flat panes of glass.
- Another common type of glass is tempered glass.
- This glass is made stronger than ordinary window glass by rapid heating and cooling of the glass surfaces.
- Tempered glass does not shatter, but fragments or dices into small squares with little splintering.
- The side and rear windows of automobiles are made of tempered glass.
- Another common type of glass is laminated glass, which derives its strength from sandwiching a layer of plastic between two ordinary pieces of windshield glass.
- Vehicle windshields are typically made of laminated glass.

Comparing Glass Fragments
- When analyzing glass, it is the forensic scientist's job to find and measure properties that will associate one glass fragment with another while minimizing or eliminating the possible existence of other sources.
- If pieces of broken glass with irregular edges can be assembled and physically fitted together, the possibility that they originated from different sources is statistically improbable.
- Most glass evidence is too fragmentary or minute to permit this type of comparison.
- The physical properties of density and refractive index are used most successfully for characterizing glass particles.
- Keep in mind that these are class characteristics that cannot individualize glass to a common source.
- Most often, forensic scientists use glass evidence to exclude glass fragments that originate from other sources.

Measuring and Comparing Density
- A solid particle will either float, sink, or remain suspended in a liquid depending on its density relative to the liquid.
- Criminalists can use this knowledge to quickly and precisely compare the densities of different samples of glass.
- Using a technique called flotation, the forensic scientist will carefully create a solution that will suspend a standard/reference sample piece of glass.
- Glass samples that the forensic scientist is analyzing can now be added to the solution.
- If they sink or float, they differ in density from the standard sample.
- If they remain suspended, then the unknown sample and the standard sample have the same density.

Determining and Comparing Refractive Index
- Recall that refractive index is the ratio of the speed of light in a vacuum (300 million m/s) to the speed of light through a glass sample.
- The best method for comparing the refractive indices of different glass samples is the immersion method.
In this method, glass particles are immersed in a liquid whose refractive index is adjusted until it equals that of the glass particles, usually done by adjusting the temperature of the liquid.

This point is known as the **match point**.

At the match point, the observer can notice the disappearance of the *Becke line*, a bright halo observed near the border of a particle in a liquid of a different refractive index.

Criminalists can place multiple glass samples in the same liquid and observe whether the match point occurs at the same time for the different glass samples.

A synchronized match point indicates a similar refractive index.

### Classification of Glass Samples
- A difference in density of refractive index can prove that two glass samples do NOT have a common origin.
- What if two pieces of glass have comparable densities and refractive indices?
- The FBI has created a database of recorded densities and refractive indices of known glass samples in the United States.
- This database allows forensic scientists to calculate the probability that two glass samples with similar properties came from the same source.

### Glass Fractures
- The way that glass breaks can reveal information about the force and direction of an impact.
- Radial fractures are cracks in glass that extend outward like the spoke of a wheel from the point at which glass was struck.
- Concentric fractures are cracks that form a rough circle around the point of impact.
- The penetration of ordinary window glass by a projectile such as a bullet or a rock will create both radial and concentric fractures.
- Although it can sometimes be difficult to determine whether a hole in glass was made by a rock or a bullet, the presence of gunpowder residue indicates damage caused by a firearm.

### Collection and Preservation of Glass Evidence
- Every effort must be made to collect all glass fragments found at the scene of a crime.
- Standard/reference samples must always be collected whenever possible.
- Suspect’s shoes and/or clothing should be collected and carefully packaged to be examined for the presence of glass samples.

### Review

1. Glass that is made stronger than ordinary window glass by introducing stress through rapid heating and cooling of the glass surface is called
   - A. Insulated glass
   - B. Tempered glass
   - C. Plasticized glass
   - D. Laminated glass

2. A bright halo that is observed near the border of a particle is immersed in a liquid of a different refractive index is known as
   - A. Refraction point
   - B. a type line
   - C. berefringence
   - D. the Becke line

3. If the density of a solid is greater than the liquid medium in which it is immersed, the object will
   - A. lose density
   - B. sink
   - C. suspend in the medium
   - D. float