



Bio-Cremation...The Game is Changing

By Paul F. Rahill

I would like to thank the organizers of the Catholic Cemetery Conference for the opportunity to participate on this panel and share some of the new ideas concerning cremation.

With the international involvement of Matthews International, we have the benefit of attending many conferences and association meetings around the world. This allows us the opportunity of exchanging ideas, concepts and current challenges with colleagues from around the world, gathering input which enhances our ability to provide total cremation solutions to our clients.

With the growth of cremation in North America, we see many crematories being located in city centers. Funeral homes currently account for 60% of all new cremation equipment installations in North America. The locations of funeral homes, of course, are in commercial areas, city centers, and even on the edges of neighborhoods. All of which requires us to be better neighbors environmentally. Consequently, cremations here in North America, with all things considered, are already viewed upon as a “green practice.” However, with the growth of cremation around the world increasing population densities in larger cities, and increasingly restrictive environmental regulations, we see new technologies emerging for the cremation market.

The scripture selected for this session is Genesis 3:19 “For dust you are, into dust you will return.” There is a common saying in our culture that there are only two certainties in life: Those being taxes and death. While it is true that death is inevitable for all of us, and we will return to the dust from which we were formed, there is a part between being born and death, and that part is called life. In this life, we have been given a responsibility. If we stay in the book of Genesis, we see in Chapter 2:15 “The Lord God took man and put him in the Garden of Eden to work it and to care for it.” Man was given a responsibility to work and care for God’s creation. So we can assume from this that it is also our responsibility to work and care for creation.

Matthews International has been a leader in cremation solutions through its various brands since 1946. We have been dedicated to research and development in the cremation field, specifically as it relates to energy conservation and environmental solutions. We were doing this work long before it was trendy. There are rare moments when we see significant advancements in technology in a specific field. We believe this is one of those moments. Bio-cremation will become a “game changer.”

Historically, cremation has been about the “**destruction**” of emissions from the cremation process. Emissions destruction is accomplished with a thermal afterburner which heats the emissions up to very high temperatures, combines them with oxygen, and combusts them to a large degree prior to discharge into the atmosphere. Greater than 95% of all crematories in the world operate under an emissions destruction concept, and have worked quite well. Of course, there is a significant amount of fuel used to achieve this destruction, and, as we all know, the combustion of fuel further adds to the emissions and “green house gases” into the environment.



With greater population densities, newer environmental regulations and increasing volumes of cremations, additional technology has emerged which focuses on **“capturing”** emissions prior to release of the exhaust to atmosphere. These filtration or abatement systems are typically combined with a traditional thermal afterburner so what we see is a combination of destruction and capture of emissions. These types of systems are commonly installed throughout Europe and work quite well. However, although they are more effective they consume even greater amounts of fuel and electricity to accomplish their function of destruction and capture of emissions – not to mention they increase typical product costs by 4 times.

Bio-cremation, as we mentioned, is a game changer. It is a very different approach. Bio-cremation is about the **“prevention”** of emissions eliminating the need for destruction and capture processes. Bio-cremation uses only 1/5 the amount of fuel/energy that the destruction and capture systems use. So we see significantly less fuel/energy utilized and we have almost zero emissions from this process. In addition, if we look at the total carbon footprint comparing process to process, we see that bio-cremation has only 20% of the carbon footprint as more traditional cremation systems. The technical process of bio-cremation is called alkaline hydrolysis. Bio-cremation is a water-based cremation process versus the traditional flame-based process. Bio-cremation takes place in a technologically advanced stainless steel cremation chamber where it uses approximately 120 gallons of water, combined with a small amount of potassium hydroxide (KOH), to break down or hydrolyze the human remains where they break down in a very controlled environment. During the bio-cremation process, the water/alkaline solution and the remains are heated to a temperature of approximately 370°F. As with flame-based cremation, the body is reduced to its basic elements of bone fragments/“ash.” Just a note on the term “ash” used for the cremated remains from the human cremation process: If you refer to the Cremation Association of North America and their discussion on the term “ash,” you find that it is really a misnomer; that there is really very little ash, but most of what we receive back are bone fragments. These bone fragments are more appropriately referred to as “cremated remains.” Back to the bio-cremation process, the end result of the process is that it generates a sterile liquid suitable for release to water treatment recycling. Bio-cremation accelerates the natural decomposition process just like flame cremation does. When we look at both of these cremation processes, what actually happens is rapid decomposition. In other words, the object is to break down the human remains back into their basic elements.

Let’s review the history of bio-cremation (alkaline hydrolysis) and its use in processing human remains. The first human application of bio-cremation was in 1998 at the University of Florida in Gainesville. This project was developed for the medical school to allow them to cremate their medical school cadavers at the end of each semester. We refer to this as an institutional installation in that it did not serve the public in and around the area. The second installation of a human bio-cremation system was in 2008 at the Mayo Clinic in Rochester, Minnesota. This too was an institutional application in that it also was used for the body donation program for cremating the remains once research was complete, and prior to the return of the cremated remains to the family. The first commercial application of bio-cremation is scheduled for the second quarter of 2010 to be installed in St. Petersburg, Florida. This installation will be at an existing funeral home and crematory complex, and will be a showcase for the use and application of bio-cremation for public service.



In the death care business, we are really in the “**transitions**” business. The transition of body to bones is inevitable, and is just not pretty. When we look at traditional burial, flame cremation or water-based bio-cremation, the starting point (body) and the ending point (bones) are the same in all three processes. We have a transition of body to bones (B2B). The difference between burial, flame cremation and bio-cremation is the catalyst each process uses and the time it takes to complete the transition. A catalyst is an accelerator; an item that encourages a chemical reaction of decomposition. Decomposition is a chemical reaction.

With burial, the body to bone (B2B) transition, takes anywhere from 5 to 20 years, depending on the preparation of the human remains, the type of casket the family selected, whether or not a vault was used in burial, and, of course, the soil type found in the cemetery. The catalyst for decomposition in burial is the soil itself, microorganisms which are found in the soil, and oxygen. The byproducts of burial are fluids that discharge into the soil and methane gas.

In traditional flame cremation, we see a body to bones (B2B) transition that takes approximately three hours. The catalyst for decomposition in flame cremation is CH₄ (natural gas) or C₃H₈ (propane) and oxygen. The byproducts from flame based cremation are exhaust that discharges water vapors, small amounts of particulate matter, greenhouse gases, CO₂, and carbon monoxide.

With bio-cremation, we have a body to bones (B2B) transition which also takes approximately three hours. The catalyst for decomposition with bio-cremation is water and potassium hydroxide (KOH) at a ratio of approximately 20 to 1. The byproducts from bio-cremation are a sterile liquid which is recycled through the water treatment systems and returned to non-potable water uses, rivers, lakes, or into deep aquifers in the earth’s surface.

Let’s take a look at the bio-cremation cycle. This is a simple step by step process that was developed to more fully explain bio-cremation.

- Step 1. The cremation chamber is loaded with the human remains.
- Step 2. The system automatically calculates the weight, the amount of water and potassium hydroxide required and initiates the bio-cremation cycle.
- Step 3. Automatically fills the chamber with the required water and potassium hydroxide.
- Step 4. Begins to heat up to the desired operating temperature of approximately 370°F - it will hold that temperature for approximately 45 minutes.
- Step 5. The cremated remains and the water/KOH solution begin a cool down process.
- Step 6. The sterile liquid is released to be recycled and renewed.
- Step 7. The cremated remains are rinsed with clean water.
- Step 8. The bone fragments are retrieved and processed into fine particles or “ash.”



If we look at the physical equipment of bio-cremation, we see that it is aesthetically pleasing. It is compact in size, it has a professional stainless steel exterior, and gives the impression of a very simple cremation system. However, if we remove a few of the beauty panels and look “under the hood,” we see that this equipment is technologically advanced. It is obvious, after a quick scan, to see the amount of precise engineering and good science that has gone into developing and manufacturing a product like this.

Since bio-cremation is new to most of us, I would like to walk through in more detail the steps of the bio-cremation process. The body in a leak-resistant (CANA approved) shroud or container is loaded into a stainless steel mesh tray used for the bio-cremation. The tray is then loaded into a rental casket, or bio-casket (for services the family wishes to conduct), using a silk cover to maintain the dignity of the human remains.

The bio-cremation unit loads horizontally, like traditional cremation equipment, and the operator uses a loading trolley to position the remains in front of the cremation chamber. The operator presses the door command on the touch screen graphical panel, and the door automatically releases its pneumatic locks and opens. We have utilized pneumatic (air) for much of the power in this operation as it is quiet and simple. Once the door is open, the cremation chamber is ready to accept the human remains. The stainless steel tray holding the human remains and the silk cover are guided into the cremation chamber. All items going into the cremation chamber must be protein based for this process. Therefore, items such as wood and cardboard are not suitable for bio-cremation. The cremation chamber is constructed with a very high grade of stainless steel. It is clean and professional in its appearance. The interior utilizes no bricks, no burners, and no insulation; just a clean, smooth, stainless steel interior.

After placement of the human remains into the cremation chamber, the operator again presses the door command, whereupon the door automatically closes, and the pneumatic cylinders lock, sealing the door. Once the door seal is confirmed, it signals that it is prepared for the cycle to begin.

The first step in the cycle is that the load cells that are integral into the frame of the bio-cremation unit, automatically weigh the human remains and the container that they are encased in. Once this weight is established, the system automatically calculates the exact amount of water and potassium hydroxide (20 to 1 ratio) which will be required for this process based specifically on this body. As we know, each body is slightly different. They come in different sizes, different bone structures, and different tissue ratios. Therefore, it is optimal to establish an individual cycle for each set of human remains. Once the cycle is established, the cremation chamber is filled with the water and potassium hydroxide (KOH). The water level will be maintained just above the human remains, and there are many sensors utilized throughout the equipment to provide input for managing the entire process.



Once we have the ideal quantity of water and KOH, the heating process begins. Heating is accomplished using specialized stainless steel steam coils located inside the cremation chamber near the bottom. These stainless steel coils maintain complete separation between the steam and the human remains. The steam is used to heat the water in the cremation chamber, which, in turn, heats the human remains. Steam circulates in the coil exchanging heat, and after the heat is extracted, the condensed steam is returned to the steam generator where this pure condensed water is recycled. The heat up process takes approximately 30 – 45 minutes, and, of course, varies with the size human remains and the starting water temperature. It is also possible, and advisable, to recycle the fresh clean water through solar panels mounted on the roof to pre-warm the water, which will, of course, reduce the energy consumption and start up time of the equipment. There are many energy saving options available with bio-cremation, again making it attractive from an environmental standpoint.

The human remains and the water are heated up to approximately 370°F where they are held for cremation approximately 45 minutes. Once the cremation is complete, the cool down process begins. To cool down the water and the cremated remains, we use the same steam coil used to heat up the process, but now we use it for cooling. In the cool down phase, cool water is circulated through the steam coils, which, in turn, captures heat out of the water and begins to lower the temperature. Again, this water is completely isolated from the cremation chamber, so the clean water with the captured energy is taken back to an insulated storage tank where this water, with stored heat, will be used for the next cycle. The cool down process also takes approximately 45 minutes.

Once the desired cool down temperature is achieved, we begin to release the fluid from the cremation chamber. The release temperature is determined by local water resource authorities and is adjustable on the bio-cremation system. The on-board computer automatically starts the fluid release process, which is simple and quiet. These fluids will be released to be reclaimed, renewed, and returned into the environment. A typical use of reclaimed water is to add it to a non-potable water source in a community, to release it into the rivers and waterways, or to place it back into the aquifers deep inside the earth.

The final phase of the process is to rinse the cremated remains with fresh water. The bone fragments remain in the stainless steel mess tray which the human remains were originally placed in, and they are safe and sterile to touch with the human hand. The bone fragments when retrieved are slightly damp, so depending on the timing for return to the family, it may be advantageous to either dry them in the cremation chamber or outside of the cremation chamber in a drying oven. Once the cremated remains are dry, they can be prepared and processed like any typical cremation using a processing system to grind the bone fragments into much smaller fragments which are often referred to as “ash.” It is notable that bio-cremated remains are much whiter than typical cremated remains due to a more complete elimination of all carbon material. The after processing appearance is a bright white very fine powder ready for placement into a permanent urn for memorialization.



With the bio-cremation cycle complete, the body to bones transition has been accomplished. While the process is different, as you have seen, the end result is the same. It is worth noting that this process has been reviewed by the National Catholic Bio-Ethics Center. You can read the report on their findings in the Bio-Ethics Quarterly, Vol. 8, Winter 2008 issue.

We, at Matthews, pledge to keep on a path of developing technology for environmental responsibility. We continue to seek new ways to care for God's creation.

Thank you again for allowing me this opportunity to share with you today the exciting things happening in cremation.

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