

Alkaline Hydrolysis as an Option for Families

Overview

Alkaline hydrolysis, more commonly known as Aquamation, is an alternative to flame-based cremation and burial. This process achieves the same end result as flame cremation, which is reduction of the body to final ash remains. It does so without burning any fossil fuels, without emitting any harmful greenhouse gases, and using 90% less energy than cremation. Additionally, mercury is not emitted to the air with Aquamation as it is with flame cremation.

The lower temperature of the process (200-300°F, compared to 1600-1800°F of flame cremation) does not vaporize this metal. Mercury is contained in dental amalgam, and it remains bound in the filling. Following Aquamation, these fillings are recycled through the same EPA recyclers that dental offices use, and are never released to the environment through air or water.

Options for services and memorialization are unchanged. Most families still hold a viewing and/or service to honor their loved one. The body may still be embalmed for transport home from another state or country, or to facilitate family wishes for traditional viewings and services. In fact, embalming chemicals are broken down completely by the Aquamation process.

The family still receives ash remains – in fact approximately 20-30% more. Anything that can be done with ashes from flame-based cremation, can also be done with ashes from this water-based process. The ashes are completely sterile and safe to handle.

By scientific definition, ashes are the inorganic minerals that remain after all organic material has been broken down. The minerals that remain from Aquamation, flame cremation, and burial after many years – are the mineral remains of the bones, or calcium phosphate.

Because the temperature of the process is approximately 1500 degrees less than flame cremation, and it uses a very gentle flow of water, more of the mineral remains are retained.

Options for ashes are endless, and people's choices depend on their religious beliefs and personal preferences.

1. Many families choose to have the ashes placed in a special urn for permanent placement in a cemetery, family plot or mausoleum, or in a columbarium.
2. Families may also bury or scatter the ashes on land or sea (as local regulations allow).

3. Many options for keeping their loved one close also exist, such as cremation jewelry or memory glass, where some of the ashes are incorporated into a piece by local artists.

How Aquamation Works

The scientific name for what happens in the Aquamation process is **alkaline hydrolysis**— a type of reaction where water molecules break the bonds of organic materials. Aquamation takes place in a state-of-the-art stainless steel system that is powered only by electricity. Just like with flame cremation where families have options for their choice of suitable cremation casket (or “cremation container”), families have options with Aquamation as well – specifically made to biodegrade in the process.

Once the deceased is placed in the system, the process works by gently circulating a heated solution of 95% water and 5% alkali around the body for an extended period of time. The flow of the water is similar to that which you would see in a small creek.

Similar to flame cremation, all that remains for the operator at the end of the process are the final bone remains (calcium phosphate) and any medical implants. Just as with flame-cremation, the final bone remains are processed into a fine ash powder for return to the family in an urn.

The medical implants from Aquamation are in remarkable condition, clean and ready for recycling. This is one of the greatest environmental benefits of this option, as those precious metals stay “in the loop” for future use instead of being buried in the ground forever.

Alkaline hydrolysis is a proven sterilization technology in which all pathogens are destroyed, as well as all chemotherapy and embalming agents (if present in the body).

Alkali is the chemical opposite of an acid. It is made from sodium and potassium salts. The alkali added to the process is based on the weight of the body, and it is completely consumed by the end of the process.

The amount of time the process takes depends on the temperature of the process. The process typically takes 4-6 hours at 302°F, or 12-14 hours at 204°F. For comparison, flame cremation typically takes place at 1600-1800°F for 2-3 hours.

The amount of water used in the process is less than a household of 4 uses in a single day – or, the equivalent to 2-3 days use of water for a single individual. The ending process water consists of 96% water, and 4% amino acids, small peptides, sugars, and salts – these are the organics of the body broken down into their most basic building blocks. There is no DNA or RNA remaining. With alkaline hydrolysis, these materials go to the local sanitation system where the water is filtered, cleaned, and recycled to the environment. With flame cremation, these same materials go into the air and subsequently the water. With burial, these materials go into the ground and subsequently the water table.

Unlike flame cremation, the ash content is composed only of the mineral calcium phosphate remains of the deceased. There is no ash content from caskets, clothing, etc.

The Family's Perspective

The numerous end-of-life choices that families must make are very personal. We have learned over time that some common sentiments expressed by families about this option include:

- They are grateful to have a choice.
- They prefer a process that does not use fire/flame.
- They prefer receiving up to 20% more of their loved ones' ashes returned to the family.
- They personally perceive this to be a gentler option than flame-based cremation.
- They value the decreased environmental impact of the process.
- If the equipment is on-site (as is possible with this emission-free technology), they are comforted by the fact that their loved one is not leaving the care of their selected funeral home.

Data analysis of cremation records (for funeral homes in the United States and Canada offering this option) has shown that 80% of families desiring cremation select this option over flame cremation. Preplanning rates are significantly higher than 80%.

Research

Modern alkaline hydrolysis technology as we know it today has been around for 30 years. During this time, the environmental benefits have been vetted by some of the best environmental agencies in the nation. While this option is sometimes recognized as "very new" in the funerary profession, it was pioneered beginning in 1995 for respectful disposition of human bodies by prestigious willed body programs like Shands Hospital at University of Florida, MAYO clinic, UTSW Medical School, UCLA School of Medicine, and now many more. It has been available to families as an option in parts of the world, primarily the United States and Canada, *for over a decade!*

Much of the research on alkaline hydrolysis exists due to its heavy adoption in the scientific fields. There are numerous published, peer-reviewed studies and complete environmental analyses on the technology. It is the preferred technology for sterilization and disposition of animal mortalities at universities, research facilities, and pharmaceutical and bio-containment laboratories because of its environmental benefits and its ability to destroy all pathogens.

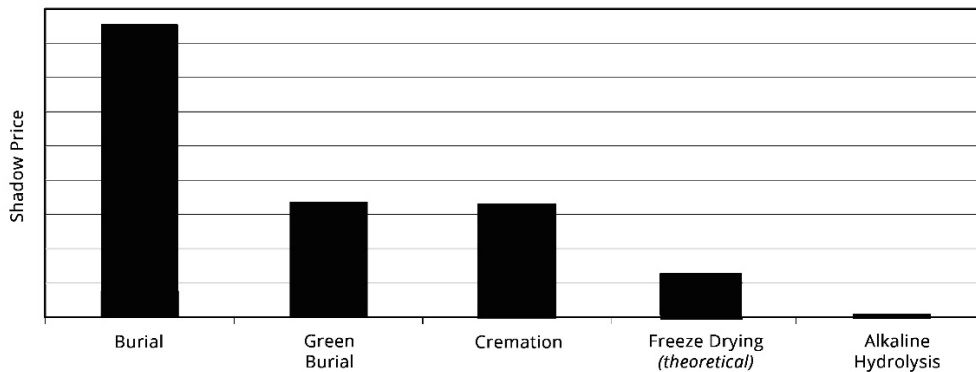
Sometimes adversaries point to its long history of use in the scientific fields as evidence that this is a waste disposal technology trying to make its way into the funerary profession. This is simply not the case. Animal mortalities must be handled through the same methods we use for final disposition of a human body, including burial, incineration (cremation), and alkaline hydrolysis.

Aquamation is an option in the funerary profession because it meets the needs of many people on many levels, including issues surrounding dignity and respect, financial needs, and cultural, religious, and social customs that precede and follow the disposition.

Alkaline hydrolysis has also been analyzed as part of an intense Live Cycle Assessment (LCA) of funerary practices, which examined the environmental impact of our customs, services, disposition, and final

placement. An LCA is a scientific study that examines a product or service from cradle to grave. A published and peer reviewed LCA found alkaline hydrolysis to have the lowest impact of all options based on the analysis of all 18 environmental impact categories. This cradle to grave approach covers all beginning to end of this option, including the manufacturing, transport, and impact of the chemical used; the source of the electricity, the water used, and the release of the process waters to the local sanitation; and the recovery and recycling of the metals following the process.

Environmental Impact of Funeral Techniques



Source: Keijzer, E.E., Kok H.J.G. TNO Report: Environmental Impact of Different Funeral Technologies. 2011.

ENVIRONMENTAL IMPACT CATEGORIES ANALYZED

- Climate change
- Ozone depletion
- Humane toxicity
- Photochemical oxidant formation
- Particulate matter formation
- Ionizing radiation
- Terrestrial acidification
- Freshwater eutrophication
- Marine eutrophication
- Terrestrial ecotoxicity
- Freshwater ecotoxicity
- Marine ecotoxicity
- Agricultural land occupation
- Urban land occupation
- Natural land transformation
- Water depletion
- Metal depletion
- Fossil depletion

References:

Denys G. Validation of the Bio-Response Solutions Human-28 Low-Temperature Alkaline Hydrolysis System. *Applied Biosafety*. 2019;24(4):182–188.

Keijzer, E. The environmental impact of activities after life: Life cycle assessment of funerals. *Int. J. Life Cycle Assess*. 2017;22: 715–730.

Keijzer EE Kok HJG. Environmental Impact of Different Funeral Technologies. *TNO Report*. 2001.

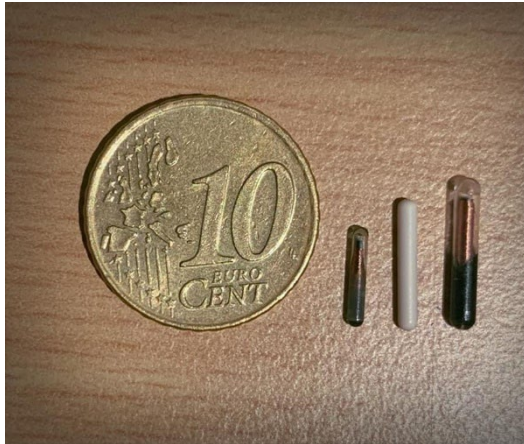
Scope: This document has been prepared by Samantha Sieber for lawmakers, regulators, and professionals as a resource for general and technical information on Aquamation. Samantha has served as a biologist in the field for over 18 years, and has helped greater than 40 states (along with many other jurisdictions worldwide) draft legislation to make this option available to families.

Appendix A: Photo References

Aquamation for Pets



Above: Photos of Aquamation systems for pets. These are often installed in vet clinics, crematories, and funeral homes to serve pet families.



Above Left: Recovered microchips from the Aquamation process

Above Right: Owl remains after the Aquamation process and owl remains after processing into final ash remains for the family

Aquamation for People



Above Left: An Aquamation system in a Maine crematory next to two flame units

Above Right: A system in a Minnesota funeral home; the unused casket room was converted for this use



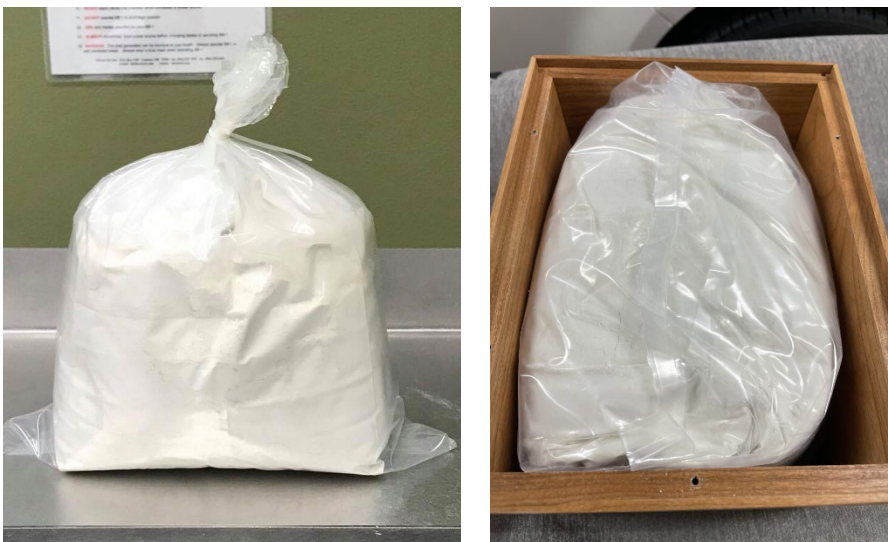
Above: A system installed in a Minnesota embalming room



Above Left: A system installed with a family viewing area in a South African funeral home

Above Right: A system installed in a Canadian funeral home

The Final Ash Remains



Above: Powdered mineral ash that will be placed in an urn for return to the family

Medical Implants



Above: Medical implants recovered from Aquamation on the left, and medical implants recovered from flame cremation on the right. Notice that with Aquamation, the implants are in excellent condition, and that pacemakers do not have to be removed.