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Sustainable End-of-Life Arrangements: An overview

Jennifer Carubia
School of Built and Natural Environment
The University of Central Lancashire
Preston, Lancashire PR1 2HE
England, UK

Faculty Advisor: Dr. Christopher N. Lowe

Abstract

The aim of this research was to assess the feasibility of implementing alternative end-of-life arrangements. Britain is predicted to run out of burial space in 30 years time with some areas having already run out and others limited to 10 years or less. Countries around the world, including America and those in Europe, seek to employ a lower carbon footprint and when coupled with an increasing population (and annual death rate) there is a need to seek alternative sustainable end-of-life processes and/or adapt current procedures to reduce their environmental impact. Current statistics show that less than 26% of the UK population opt for burial as an end of life arrangement. Although this appears to be a low percentage, this figure is still over 200,000 people per year. The remaining 74.4% of people in UK currently choose to be cremated. Crematoria around the world emit both CO2 and mercury which contribute significantly to the anthropological impact on the planet. This research sought to assess the acceptance of alternative and/or adapted methods within a broader context of land space, toxic emissions and public and religious requirements. In order to explore this, primary and secondary data was collected through a review of pertinent literature and semi-structured interviews were conducted with industry professionals. Findings suggested that more sustainable alternative processes including Alkaline Hydrolysis (also known as Resomation©) and Cryomation, are not likely to be implemented in the UK in the short-term (though Resomation is currently in practice in seven US states), and adaptation of current methods is key to reducing the current environmental impact of the funeral industry. Adaptations include "green" or "natural" burial, a technique known as "lift and deepen" and the potential use of renewable energy within crematoria. Furthermore, this research has suggested that the funeral service element of the process has potentially the greatest environmental impact (corroborating the findings of the recent study by Keijzer[1]). Further detailed investigation into this preliminary stage of the end-of-life process in the UK and in other countries, including America, is being developed.

Keywords: Sustainability, Death, Land-use

1. Introduction

People are becoming more aware of the impact that their activities have on the environment, this has led to an increasing desire to reduce their impact upon death. The growing population and increasing number of deaths per year inevitably results in a higher number of burials and cremations globally. In the UK, remaining burial space is scarce and crematoria emissions have become a more concerning and influential factor when considering choice of end of life arrangements. Adaptations to many industries and household products are steadily being introduced to combat greenhouse gas emissions and fossil fuel usage, and increase sustainability. To address this two new, innovative and potentially more sustainable end-of-life processes are currently being developed; alkaline hydrolysis, known commonly as its patented name Resomation® and as it will be referred to in this article, and Cryomation.

2. New Processes

2.1. Resomation

The process of resomation is very similar to the more traditional process of cremation. After the funeral service the coffin is placed inside a metal box which is then filled with a water-alkali mix and is heated under pressure to temperatures around 350°F for 3 hours until the body is dissolved, leaving the bones and a sterile liquid which can be potentially returned to the water cycle. The bones are then placed in a cremulator and converted into ash which is given to the relatives. In contrast to cremation, resomation produces no CO_2 or mercury emissions (associated with amalgam dental fillings), and the process allows for orthopaedic metals to be recycled. In addition resomation does not require a purpose-built building as equipment can be retrofitted inside existing crematoria. Resomation is currently legal and available in seven US states[2] and 60 countries have expressed an interest in adopting the process[3].

2.2. Cryomation

Cryomation is still in the developmental stages and involves dehydration of the body prior to being frozen in liquid nitrogen and fragmented (between vibrating metal plates) to produce an ash which can be returned to relatives. The cryomation process does not produce any atmospheric emissions and also allows for the retrieval and recycling of orthopaedic metals. However the process would require purpose-built centres as the equipment is too large to be retrofitted into existing crematoria.

2.3. Implementation

Neither resomation nor cryomation are currently illegal in the UK, but any disposal of human remains other than burial or cremation currently requires an investigation and certification, both provided by the Chartered Institute of Environmental Health. When approached on the subject EH stated that "although they could issue certification, without a change in the legislation surrounding ethical disposal and certification so that they would not hold responsibility, they would not issue the certification"[4]. Without change to current legislation so that certification could be issued by the centre performing the process, it is suggested that these processes will not be available due to a lack of acceptance by Environmental Health. However a more significant barrier (in the short-term) to the adoption of these new end-of-life practices may be public acceptance. Cremation was introduced through the Cremation Act of 1902[5] but was initially met with both public and religious objection and it was not until 1968 that cremation overtook burial as the most frequently utilised end of life option[6]. Some religions do not allow cremation such as Judaism and Islam, and some advocate cremation such as Hinduism. These traditions have often developed for practical reasons. For example, the Indian Muslim practice is to bury the deceased as quickly as possible[7], normally within 24 hours of death[8], this practice is associated with the hot climate in India, and the rapid rates of decay and lack of sanitary hygiene. It is also common practice in some European countries to bury and to exhume within twenty four months, for the body to then be cremated and reburied in a wall vault[9]. This process enables the cemetery to re-use grave plots while keeping all bodies within the grounds.

3. Current Processes

3.1. Cremation

Currently, 74.4% of the UK population are cremated upon death, and the rate of cremation is increasing annually[10]. Though crematoria are not widely associated with greenhouse gas emissions it cannot be disputed that carbon dioxide (CO_2) and mercury emissions contribute to the anthropogenic impact on the environment. Exposure to mercury is linked to brain damage, nervous system and fertility problems, and it was estimated that crematoria were liable for 16% of the total mercury emissions in the UK in 2005 with abatement equipment installed to reduce this figure by half[11], though no data is available at present regarding the level of mercury pollution from crematoria in 2013.

Cremation uses much less land space, but a large proportion of people still wish to bury the ashes or erect a small memorial. Cremation also uses less energy than burial as shown in figure 1, but natural gas is used to heat the crematoria chambers, and emits CO_2 and other pollutants (including mercury if the deceased has any amalgam dental fillings) into the atmosphere. The CO_2 released from crematoria is approximately 100 kg per

person, with ¼ coming from the coffin and ¾ from the body itself, known as biogenic gas[12]; however this figure does not include natural gases. Natural gases are analysed separately as these are the emissions that allow leeway in terms of becoming more sustainable, as biogenic gases cannot be altered. The term "natural gas" in this context refers to the fossil fuel consumption of the crematoria. On average, the crematorium uses 879 mj of natural gas which equates to roughly 30 kg of CO_2 per cremation, which may be lowered by using renewable energy such as solar powered lighting and heating inside the crematorium. Solar crematoria are currently being developed in India; this potentially sustainable adaptation uses Scheffler reflectors of $50m^2$ to provide heat almost equal to that of a standard crematorium furnace[13]. Though this process is not likely to be implemented in the UK, by switching from gas powered electricity in the crematorium buildings to solar power or wind power, the environmental impact may be reduced.

Emissions from crematoria are a major point source for mercury emissions in the UK and are largely responsible for legislation requiring crematoria to have pollution abatement systems in place, such as the Pollution Prevention and Control Regulations 2000, formerly the Environmental Protection Act 1990, though the CO_2 emissions are not quite as worrying as it may seem when compared with other trades as Keijzer[14] explains. Burial, cremation, cryomation and resomation have a much lower energy consumption than the the funeral process and the industries associated with this part. Resomation has notably the lowest energy consumption, and cremation and burial are only marginally higher than cryomation. It must be noted that figures of energy consumption for burial are considerably higher than that of cremation, as all aspects of burial including mechanical diggers and engraving and transportation of any monuments erected are included in energy consumption statistics.

3.2. Burial

Traditional burial, by means of a wooden coffin interred in a local authority or privately owned cemetery, as an end-of-life arrangement is becoming restricted. It has been estimated that England and Wales will run out of burial space in 30 years time. However burial can only take place in suitable soil conditions; "the soil of a burial ground must be openly porous and elevated above the groundwater of the locality, allowing for water and air to pass through freely thus not interrupting the rate of decay"[15]. This factor limits the land space available, and with a vast amount of land allocated to burial over the centuries, the availability of land for future burials appears sparse. Aside from the impact that burial has on land space, items placed inside the coffin before interment and the materials on the coffin itself, such as plastic or metal handles and plaques, are often not bio-degradable. The use of formaldehyde as an embalming fluid also has a negative environmental impact as leaching of this carcinogen has been linked to a range of medical problems including respiratory issues and cancer. However, the effects of this leaching are disputed as some scientists say that once formaldehyde reaches the soil it oxidises quickly and becomes a neutral element. The embalming process drains the cadaver of blood to replace it with formaldehyde, decreasing the rate of decomposition and cleansing the body of disease; this is a widely used process in the United States of America as an open casket service is very popular. In the UK, where open casket burial is uncommon, embalming is not necessary for burial or required by law unless international repatriation is to take place[16].

3.3. Sustainable Adaptation

There is a growing demand for more sustainable end-of-life practices. However, as already outlined this demand cannot currently be met by either resomation or cryomation. Therefore attention has turned to addressing the environmental impacts of burial and cremation, and the potential of making these traditional methods more sustainable. At present there are over 260 natural burial grounds in the UK[17], allowing the option to inter more sustainably, though tradition and location will inevitably have an influence for many people. The term "natural" or "green" burial refers to a more eco-friendly and sustainable method of interment and accounts for approximately 5,000 burials per year in the UK[18]. Natural burial is not strictly bound to interment in a bramble strewn wilderness, though this is an option if it is to personal taste, but can be as simple as purchasing an "eco-coffin" such as a woollen shroud, cardboard or willow coffin. An eco-coffin can be buried either in a cemetery or in a natural burial ground with a tree, plant or other eco-friendly memorial to replace the headstone. Not only is this better for the environment but it may also be cheaper than traditional burial as the limited availability of cemetery plots and the demand for land in urban areas is increasing the price of traditional burials. For example the cost of council owned lawn burial plots in Cornwall has increased from £708 in 2011 to £1,455 in 2012[19]. Similarly, as fossil fuel resources are gradually diminishing, the price of natural gas is projected to increase, raising the cost of cremation. Currently cremation is a much cheaper alternative than traditional burial with rates in Preston, Lancashire, of £565.96[20] for cremation compared with the price of a local burial plot which starts at £899 for residents, with fees tripling for non-residents[21].

One alternative to single grave burial in regions that are restricted for space (e.g. urban centres) is a process referred to as "lift and deepen". This allows graves that are a minimum of 100 years old to be reopened and the remains of the deceased buried deeper, leaving room for up to 6 more coffins above them[22]. However, public feedback in the UK on this proposal has been extremely negative, and widely viewed as insensitive. Another option available for interment is vertical burial; this is common at hillside natural burial sites, where the body is interred vertically in a bio-degradable shroud which produces a much smaller footprint. The first vertical burial took place in the UK in 1800[23] and the first vertical cemetery was built in Australia in 2010 with fees approximately half that of traditional horizontal burial.

It should also be recognised that cemeteries and memorial parks have important social and environmental benefits. They are often beautiful places filled with history and heritage, plants and wildlife, memories and love, a place where people can gather to remember their loved ones and witness the sanctity of the nature around them. Cemeteries also act as part of the provision for green spaces in urban areas and allow for biodiversity and connectivity of wildlife. Various flora and fauna occupy cemeteries, and some utilise such sites as corridors through urban centres.

4. Preliminary Stage

When analysing the immediate and short term impact of the funeral industry, the funeral service itself, or "preliminary stage" as it is referred to, is the most damaging; though the type of service accompanying a natural burial would have a significantly lower impact than what may be considered "normal". The preliminary stage is noted in figure 1 to have more of an impact environmentally through energy consumption than the four processes compared during this research, but is still much lower when compared like for like than that of other industrial sectors. In a typical traditional burial there are damaging factors present such as cars as a method of transport to and from the service, invitations and commiserations sent out by post, wastefully packaged food items that are offered at the ceremony and the use of imported flowers. Flowers at a funeral service may be tradition but unfortunately have a significant impact on the environment. The majority of flowers used at funeral services in the UK are imported and may have been flown thousands of miles and are often wrapped in non-recyclable, non-degradable cellophane. But the expanded floral foam (known as oasis) that they often stand in is potentially more detrimental to the environment as it is made from non-biodegradable phenolic resin[24]. Oasis, if squeezed thoroughly, can be reduced to around 30% of its original volume, using much less space at landfill, though this is not widely advertised, nor practiced. Many natural burials occur in places that can be hard to reach by car and so visitors must attend the service on foot. Due to the nature of these sites, flowers in plastic wrapping are often dissuaded as they can negatively impact these often natural sites.

Many issues surrounding the sustainability of end of life arrangements can be adapted to be more "green" through altering public perception and by gentle awareness raising due to the sensitivity of the subject. By promoting sustainability alongside tradition, e.g. "natural" burial is very much like traditional burial though the surroundings and materials used may be altered, this can be achieved. Although there are new, innovative and potentially sustainable alternatives under development, these are not likely to become functional in the UK in the near future and so adaptation and adjustment of current methods is advocated. By reducing the importation of flowers, and the cellophane and oasis associated with flowers, the non-recyclable waste from such sites can be reduced dramatically. Similarly, by encouraging non-embalmed interment in natural wooded burial grounds, either vertically or traditionally horizontally, in an eco-coffin, there is potential to reduce the leaching of formaldehyde or the chemicals associated with the treatment of wooden coffins, as well as decreasing the rate that cemetery space is diminishing. By highlighting the impact of both cremation, interment, and the proposed alternatives, it is accepted that the "preliminary stage" (the ceremony) often has a greater detrimental impact on the environment than the choice of the end-of-life practice. It is suggested that current processes should be adjusted accordingly, and with immediacy, to enable the funeral industry in the UK to meet the growing environmental concerns of the industry and the public.

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