Volcanic Ash – Health Hazards

A guide for the public

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Directorate of Health
Chief Epidemiologist for Iceland

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LANDSPÍTALI
UNIVERSITY HOSPITAL

DEPARTMENT OF CIVIL PROTECTION
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Icelandic Food and Veterinary Authority

This publication

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- The Chief Epidemiologist, https://island.is/eldgos
- The Department of Civil Protection, https://www.almannavarnir.is/
- The Environmental Agency of Iceland, www.loftgaedi.is
- The Icelandic Met Office, www.vedur.is
- The Red Cross in Iceland, www.raudikrossinn.is
- Landspítali University Hospital, www.landspitali.is
- The Icelandic Food and Veterinary Authority, www.mast.is

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Contents

Glossary

Word	Explanation
Volcanic ash	Ash from a volcanic eruption texture can vary in texture from coarse, like sand, to fine, like cement dust.
Particle matter	Particles in the air of various type and size.
Exposure	To be exposed to something, e.g. to breath in volcanic ash.
Ash fall	When volcanic ash settles to the ground.
Ash suspension	When ash that has settled is resuspended into the air.

Key Points

Recommendations for protection against health effects of volcanic ash are based on information about the size of ash particles and the chemical analysis conducted by the University of Iceland.

The health effects of volcanic ash can be diverse, both direct and indirect. Direct effects may involve both physical and mental aspects, while indirect effects can impact people's homes and possessions, affecting vital infrastructure like drinking water and electricity. Although ash is not immediately harmful to health, everyone is advised to avoid inhaling ash as much as possible. Individuals with respiratory or cardiovascular diseases, as well as children and the elderly, may be particularly vulnerable to health issues due to ash exposure.

People residing near active volcanoes are encouraged to have a preparedness kit containing safety goggles, dust masks, and water to use in case of a volcanic eruption or ashfall.

What to Do in Case of Ashfall?

- Stay calm.
- Stay indoors as much as possible and close doors and windows.
- Seek shelter if you are outdoors.
- If you are outside during ashfall, wear a face mask, cloth, or a „buff“ covering your nose and mouth, and use protective goggles.
- Follow the recommendations of the Civil Protection regarding responses to ashfall.
- Monitor information about the volcanic eruption and cleanup plans in the media.
- Avoid wearing contact lenses as ash can accumulate behind them, causing irritation.

Actions When Heavy Ashfall is Predicted

- Stay indoors. Close doors and windows.
- Place wet towels at thresholds and other places where doors or windows may not be airtight.
- Turn off air conditioning and heating systems where applicable.
- Protect electronic equipment by covering or packing it, e.g., in plastic wrap, and do not uncover it until the ash in the vicinity has been cleaned up.
- Note that ash can block drains, such as those on roofs.
- Individuals with chronic respiratory orcardiovascular diseases should stay indoors and avoid unnecessary exposure to ash. Outdoor use of masks and protective goggles is recommended.
- Ensure that livestock has access to clean water and feed, if possible.
- Parents and caretakers of children should familiarize themselves with the school's emergency plan and plan recreational activities in case of closure.

Other Useful Measures in Anticipation of Ashfall

- Have an adequate supply of necessary medications for both people and pets.
- Have available cleaning supplies such as brooms, dustpans, and vacuum bags, as well as shovels and bags to clean and collect ash.
- Keep several days' worth of food and clean drinking water in bottles.
- Keep pets indoors. If they have been outside, brush them off before allowing them inside.

The Icelandic Red Cross has provided comprehensive guidelines on preparing for natural disasters, which can be explored on their website: 3dagar.is.

Volcanic Ashfall

The amount of ash can be significant both during an eruption (ashfall) and in the aftermath when ash that has settled is lifted back into the air (ash resuspension). Ash resuspension can persist for many weeks or even months after the volcanic eruption has ended. The characteristics of ash vary depending on the type of volcanic eruption. The color of the ash can range from light gray to black, and the texture can vary from coarse, like sand, to fine, like cement dust. The finer the ash, the greater the risk of it reaching the lungs. Ash in large quantities can block sunlight, reduce visibility like fog, or even cause complete darkness during the day. Freshly fallen ash may contain acidic particles that can irritate the lungs and eyes. This acid is washed away by rain and the weathering of the ash over time.

Health Effects

The health effects of volcanic ash can be diverse, both direct and indirect. Direct effects can include both physical and mental impacts, while indirect effects may affect people's homes and possessions, influencing critical societal infrastructure such as drinking water and electricity.

Although volcanic ash is not immediately dangerous to the general population, everyone is advised to avoid inhaling ash as much as possible. Individuals with respiratory or cardiovascular diseases, as well as children and the elderly, may be particularly vulnerable to health issues due to ash exposure.

Physical Effects of Volcanic Ash

It's crucial to remember that the health effects of volcanic ash are primarily dependent on the size of the particles, with smaller particles posing a greater risk to health than larger ones. Larger particles are filtered out in the nose and upper airways, while smaller particles can reach the lungs. The tiniest particles can enter the lung's air sacs (alveoli) and spread throughout the body, affecting various organs.

Breathing in volcanic ash is associated with an increased frequency of respiratory, cardiovascular, and vascular diseases. Elderly individuals, children, and those with underlying respiratory, cardiovascular, or vascular diseases are more susceptible to all types of air pollution. The effects can occur both due to short-term exposure (hours, days) and long-term exposure (months, years). The effects can manifest as exacerbation of existing disease symptoms, leading to an increase in emergency room visits, hospitalizations, and increased mortality.

It's important to emphasize that people with respiratory, cardiovascular, or vascular diseases may experience worsening symptoms that can last for many days, including coughing, shortness of breath, and chest tightness.

Acute symptoms may appear quickly after individuals are exposed to volcanic ash. Below is a list of possible acute symptoms that may emerge within a few hours or days:

- Respiratory System:
    - Nasal irritation and congestion
    - Throat soreness and coughing
- Eyes:
    - Feeling of a foreign objects
    - Eye redness, itching, and tearing
    - Eye discharge and tearing
    - Scratching on the cornea
    - Acute conjunctivitis, sensitivity to light
- Skin:
    - Irritation
    - Burning
    - Redness
    - Itching

Children

Children face the same risks from ash as other age groups, but the impact on them can be greater due to their ongoing physical development and growth. Additionally, children breathe at faster rate than adults, exposing them to a proportionally higher pollution load. Moreover, being shorter in height, they are closer to the ash settled on the ground.

Measures Against Effects of Volcanic Ash on Health

Here are some advice and precautions to follow in order to cope with the effects of volcanic ash.

Measures Against Effects on Physical health:

On the website of the Environment Agency of Icelandic, loftgaedi.is, you can monitor the quality of the air. Real-time concentrations of particulate matter are displayed, providing valuable information about air quality at any given time.

The Icelandic Met Office provides forecasts for volcanic ashfall or ash resuspension, see vedur.is. It is advisable to follow these forecasts for insights into potential volcanic ash impacts.

General Recommendations

- Individuals with respiratory or cardiovascular diseases should ensure they have their medications available.

- Breathing through the nose is recommended to minimize inhalation of pollutants.
- Avoid strenuous outdoor physical activity and exercises, such as running and hiking, when the concentration of volcanic ash in the air is high.
- Organizers of sports events should postpone competitions and exercises when volcanic ash is present in the air, especially if children are involved.
- Those who must be outside should use dust masks and protective goggles.
- Prolonged outdoor activities for children are not recommended, and young children should not sleep outside in a carriage when volcanic ash is present in the air.
- Staying indoors with closed windows and turning off air-conditioning and heating systems provides significant protection against air pollution.

Face Masks

Face masks are important to reduce the risk of inhaling volcanic ash particles and mitigate the harmful effects of volcanic ash. Using a dust mask is beneficial during ashfall and ash resuspension, especially in windy conditions. Such masks are generally available in building supply stores.

Categories of dust masks based on filtration:
P1 masks prevent approx. 80% of particles less than 0.5 micrometers in size
P2 masks prevent approx. 94% of particles less than 0.5 micrometers in size
P3 masks prevent approx. 99,95% of particles less than 0.5 micrometers in size

So-called surgical masks, similar to those used in healthcare, are not intended to provide protection against small particles, such as volcanic ash, primarily because they do not create a tight seal around the face. However, they can offer some protection and can be used as an alternative when other options are not available.

Example of a surgical mask

In general, P2 masks are recommended to guard against volcanic ash. The use of P3 masks is not considered necessary. The choice between P2 and P3 masks is subjective, with some finding P2 and P3 masks uncomfortable. P1 masks provide the least resistance, and for those who find breathing through P2 masks uncomfortable, P1 masks are indeed a suitable option as they still effectively block most ash particles.

Example of a dust mask

There is often little difference in appearance between P1 and P2 masks, so carefully examine packaging and seek advice from sales staff when purchasing masks. P2 masks with exhalation valves, facilitating easier breathing, are available.

If masks are unavailable, makeshift options such as using fabric, like a cloth or a "buff," can help prevent larger ash particles and irritation in the throat, nose, and eyes.

Protective Goggles

It is always recommended to use protective goggles during ashfall. Goggles should form a tight seal around the face. Also, use eyeglasses instead of contact lenses to shield the eyes from irritation. Those participating in cleanup operations should always use both dust masks and protective goggles.

Example of protective goggles

For Children

Although the health effects of inhaling small amounts of ash are not typically long-lasting, the following precautions are recommended for children during volcanic ashfall or ash resuspension:

- Keep children indoors when the concentration of ash in the air is high. See loftgaedi.is.
- Do not allow children to sleep outside during ashfall or ash resuspension.
- Children should avoid strenuous outdoor activities, such as play and running when ash is present in the air.
- If children must be outside during ashfall or ash resuspension, they should use dust masks.
- Ensure that children do not play in areas with visible ash layers or where ash has collected.

Measures to Protect Mental Health

Extended stays in areas with significant ashfall can impact people's mental well-being. The environment becomes gray and monotonous, the distinction between day and night becomes unclear, and everything becomes dusty and unclean. Even simple tasks can become overwhelming in such conditions. Seeking assistance, such as cleaning ash from homes, is essential.

Maintaining a daily routine, including meal and sleep times, is crucial. Expressing feelings and seeking support from others are important. Take advantage of psychosocial support available. Engaging in social activities, events, and other leisure activities can prevent social isolation. Stay connected with friends or family through phone or social media. Regularly seek a change of scenery, if possible, such as visiting friends or family outside ash-affected areas.

The Red Cross helpline at 1717 is always available for assistance, and additional reading material on mental support can be found on the Red Cross website.

Indirect Effects of Volcanic Ash

In addition to health risks, there are indirect effects of heavy ashfall. Ash differs from regular dust and can scratch and abrade surfaces if swept or wiped off. Ash can infiltrate everywhere, including household appliances, computers, cameras, and other equipment, causing considerable damage. Ashfall can have widespread impacts on properties and the environment. Roofs may collapse under the weight of ash, leading to accidents or severe damage, and window panes may be damaged by ash. Gutter systems may become clogged.

Additonal Preparations for Expected Ashfall

- Have an adequate supply of necessary medications for both people and pets.
- Have available cleaning supplies such as brooms, dustpans, and vacuum bags, as well as shovels and bags to clean and collect ash.
- Keep several days' worth of food and clean drinking water in bottles.
- Keep pets indoors. If they have been outside, brush them off before allowing them inside.

The Icelandic Red Cross has provided comprehensive guidelines on preparing for natural disasters, which can be explored on their website: 3dagar.is.

Preparations for Expected Ashfall

When ashfall is anticipated, consider the following preparations:

- Cover gutters to prevent ash from entering them. Be cautious when going onto roofs, as ash can cause slippery conditions.
- Wrap electrical appliances in plastic wrap to shield them from ash.
- Have a portable radio that runs on batteries and have extra batteries on hand.
- Have a flashlight available and extra batteries.
- Cover hot tubs and related equipment to prevent ash contamination.
- The most effective way to prevent damage to outdoor equipment is to turn it off and seal or shield it until the ash has been removed from the immediate vicinity.

Critical Infrastructure

Roads

Reduced visibility due to ash can obscure road markings and cause accidents. Thin layers of ash can lead to slippery conditions. Thick ash deposits can make roads impassable, hindering access to essential supplies. Ash can also damage vehicles.

- Avoid driving unless absolutely necessary.
- If driving is necessary, maintain a safe distance between vehicles and drive cautiously.

Electricity

Ashfall can lead to power outages. Wet ash can conduct electricity, increasing the risk of electric shock. Caution is necessary when dealing with electrical equipment.

Drinking Water

Ashfall can contaminate water sources and damage water supply equipment. Small, open water tanks are particularly vulnerable to ashfall. Even a small amount of ash can make water unsafe for drinking. While the risk of poisoning may be low, the water's acidity levels can rise.

- Monitor information from health authorities and water utilities regarding the safety of drinking water and follow official recommendations.

Waste Management and Trash Collection

Municipal trash collection and wastewater facilities may be disrupted by ashfall, causing inconvenience.

- Make arrangements to address accumulated trash.
- Follow official information and guidance from the local municipality.

Cleaning Ash

Indoor Cleaning

The amount of ash entering homes depends on how airtight windows and entrances are and how carefully one prevents ash from being brought in on shoes and clothing.

Generally, use a vacuum cleaner on surfaces to remove ash from carpets, furniture, office equipment, household appliances, and other similar items. It is recommended to vacuum ash and regularly change the vacuum bag or clean the filter.

Good advice for indoor cleaning:

- Put on a dust mask before starting the cleaning process. If you don't have a mask, use a cloth or "buff."
- Use only one entrance to the house while cleaning to minimize the risk of residents carrying ash into cleaned areas.
- After vacuuming, wash carpets and furniture covers with cleaning products. Be careful not to rub too hard, as ash can damage fabric.
- Clean floors with a damp mop or wet cloth. If there's a thick layer of ash on the floors, moisten it slightly before sweeping (avoid sweeping dry ash).
- Avoid blowing ash into the air. Do not clean by blowing or sweeping dry ash, as it may resuspend ash into the air. Use a damp cloth to clean surfaces, using water and suitable cleaning products.
- Glass, porcelain, and acrylic surfaces can scratch if dry-cleaned vigorously. Use a damp cloth or sponge with soap or cleaning products and wipe gently.
- Fine ash can scratch wood finishes. Vacuum the surfaces first and then wipe with a cloth. Using adhesive cloths (similar to furniture polish cloths) can also be helpful.
- Wash ash-covered fabric in running water and then launder gently or, if suitable, shake it outside to remove ash.
- Brush or shake off excess ash on outdoor furniture before washing. Disconnect electronic devices before cleaning them with a vacuum.
- In a few months after ashfall, filters, especially in air-conditioning and heating systems, may need frequent replacement.
- Clean all surfaces that might blow air and suspend ash. Do not use fans or dryers that have not been cleaned, as they can displace ash into the air.
- Clean vents and fans connected to ovens thoroughly.

Outdoor Cleaning

Rain and wind are effective in removing ash. Grass and other vegetation can bind ash to the soil, but this process may be slow when ashfall is heavy. Therefore, ash needs to be cleared from populated areas and transported away. Additionally, winds can blow ash over previously unaffected areas. Ash can persist in the environment for months or even years after a volcanic eruption. It is advisable to coordinate cleaning efforts with neighbors and conduct larger cleaning operations in neighborhoods or communities.

- Those involved in cleaning should always wear dust masks and safety goggles.
- Sprinkle or spray water lightly on ash. This reduces the chance of wind redistributing the ash. Do not soak the ash, as it hardens into a solid mass, making cleaning more difficult.
- Clean ash from roofs cautiously. Keep in mind that there is a risk of roofs collapsing under added weight while cleaning. Use safety harnesses during roof cleaning.
- Use a shovel to remove a significant amount of thick ash (if more than 1 cm). A stiff broom can be used for smaller amounts.
- Only mow grass and remove weeds after rain or spraying with water and collect waste in bags.
- Do not dispose of ash in gardens, sidewalks, or streets. Place ash in thick plastic bags or on utility vehicles if available.
- In most cases, ash should be separated from other waste and disposed of in predetermined locations. Consult with municipal employees about disposal guidelines.
- After being outdoors and exposed to ash remove coats etc. before going indoors.

Pets, Livestock and Food Safety

Pets and Livestock

The risk posed by ashfall to livestock depends on the season, the quantity of fluorine and other substances in the ash, and the type of livestock, as certain animals, especially ruminants, are more sensitive to fluoride poisoning. Prevent, if possible, ashfall on animals and their feed, and ensure access to clean drinking water. If ash falls on fields it is safer to delay harvesting until after rain. The same applies to grazing pastureland. Fluorine disperses rapidly, and the risk of poisoning diminishes after it rains. If ash contaminated with fluoride falls on hay, the fluoride content, which could be transmitted to the animals, needs to be assessed, and decisions about hay usage should be made accordingly.

Depending on the circumstances, the following measures may be needed:

- Shelter animals from ashfall or move them elsewhere if possible.
- Ensure animals have access to clean drinking water. Inspect water troughs and prevent surface water from entering them. Keep running water available to animals outdoors.
- Give animals ample and high-quality feed, provide access to salt licks, and keep them away from pasture as much as possible. Take precautions to prevent ash from settling on feed.
- Ensure that ash does not enter animal shelters and barns.
- It is essential to prevent animals from drinking contaminated water and keep them indoors as much as possible.

Food Safety

It is safe to consume vegetables grown outside if ash has fallen on them after they have been washed with clean water.

Useful information

- The Chief Epidemiologist, https://island.is/eldgos
- The Department of Civil Protection, https://www.almannavarnir.is/
- The Environmental Agency of Iceland, www.loftgaedi.is
- The Icelandic Met Office, www.vedur.is
- The Red Cross in Iceland, www.raudikrossinn.is