

## LIST OF BEST MATERIALS FOR OUTDOOR SCULPTURES

- Metals (bronze, iron, steel, brass...)
- Stone (better ones are the less porous)
- Clay (ceramic terracotta or brick-like material. Less porous ceramics are better)
- Some glass (normally the ones that do not have dyes in it)
- Fiber glass (or any other new modern durable material)
- Cement (cement has a lot of salts that combined with other materials can be harmful. See below what I explain about water)

In general: porous materials and water irrigation can be harmful. Some materials will also negatively be impacted by sunlight (like dyes in glass or paint). These are the reasons:

### NEGATIVE IMPACT OF ENVIRONMENT (WATER, SUNLIGHT, TEMPERATURE)

**WATER-** Water can either directly dissolve some materials (like stone, metal, or ceramic) or wear it away by carrying abrasive particles over its surface. Water can also deteriorate materials when it freezes and turns to ice. Ice crystals have greater volume than liquid water, and when water is contained in the porous structure of the material and then freezes, the resulting ice crystals place enormous stress on the pore walls. This stress leads to microfractures in the structure of the material. If the ice then melts, migrates to another location in the porous material, and freezes again (as will happen with the changing of seasons in temperate climates), it begins what is called a "freeze-thaw cycle," in which repeated migration and freezing of the water causes the material to lose cohesive strength, particularly near the surface. Freeze-thaw cycles can result in spalling, or delamination of the material surface, eventually leaving no more than a shapeless mass in a relatively short amount of time.

Water can also carry soluble salts into the porous structure of material. These salts stay in solution and travel through the pores of the material until the water begins to evaporate at the surface of the sculpture. Upon losing water, the salt will effloresce. Salt crystals, like ice crystals, have greater volume and place greater stresses on the pore walls, which leads to the same flaking or spalling caused by the freeze-thaw cycle. When the majority of the soluble salt crystallizes at the surface of the sculpture and forms a white powdery deposit, the process is defined as "surface-efflorescence." Although this process is unsightly and can cause damage, it is not as destructive as "subefflorescence," which occurs when the salt crystallizes in the pores of the sculpture below the actual surface. In the process of subefflorescence, the salt crystals are contained within the pores and hence place enormous pressure on the pore walls. Materials acquire salts from the environment, such as during burial, when they are exposed to groundwater laden with salt, or when they are exposed to water that has percolated through natural or man-made material (such as gypsum or cement) that also contains large amounts of salt.

### LIGHT

UV Radiation: Rays are energy that can decompose material to the molecular level

Visible and invisible rays in the electromagnetic spectrum (mainly UV rays) damage materials  
High relative humidity and some pigments can act as catalyst accelerating the decomposition

## TEMPERATURE

- **Too high** – Damp (over 65% RH) – causes:
  - mold and
  - corrosion and
  - gradual disintegration or discoloration of organics
- **Too low** – can produce:
  - changes in the physical properties of materials.
  - Supports hydrolysis that gradually disintegrates and discolors organics.
  - Causes desiccation, which results in fractures, cracks, shrinking, etc. , mainly in hygroscopic materials.
- **Fluctuations** –
  - shrink and swell unconstrained organics,
  - cause layered organics to delaminate,
  - tent and/or buckles,
  - loosens joints in organic components.
  - Causes relative humidity fluctuations