Preservation of General Purpose Polystyrene (GPPS) sculptures – heat modeling in *Pequenas Esculturas* (1975) by Ângelo de Sousa

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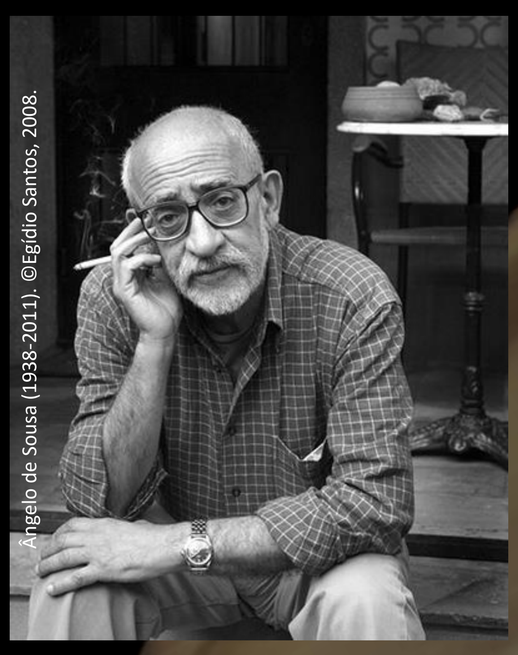
Introduction



Ângelo de Sousa (1938-2011). ©Egídio Santos, 2008.

Ângelo de Sousa (1938-2011) is one of the major Portuguese contemporary artists. Ângelo, as he chose to sign his works, graduated from the School of Fine Arts in Porto (Portugal) where he became a professor from 1963-2000. His works cover various art forms such as painting, sculpture, drawing, photography and film. Since the early 1960s Ângelo chose synthetic paints as his painting medium and his curiosity led him to occasionally explore plastics in sculpture, as in the series of General Purpose Polystyrene (GPPS) sculptures *Pequenas Esculturas,* 1975. The access to the naturally aged dated material references found in Ângelo's studio has been extremely important for the development of the present work.

The main focus of this work is to evaluate whether the heat modeling process of GPPS will undermine the preservation of *Pequenas Esculturas* in the future. For that matter, an investigation on the materials and techniques employed in the manufacture of GPPS yogurt and butter containers in the 1970s has been carried out and complemented by material characterization of the artist's reference pots, and of the sculptures by ATR-FTIR (Attenuated Total Reflectance Fourier Transform Infrared Spectroscopy) and EDXRF (Energy Dispersive X-Ray Fluorescence Spectroscopy). Also using ATR-FTIR, the main photodegradation products were identified and compared with artificially aged samples modeled and unmodeled GPPS pots. FORS (Fibre Optics Reflectance Spectroscopy) has been a useful tool to detect the earliest stages of color change.

The GPPS sculptures: *Pequenas Esculturas*, 1975

Pequenos Esculturas, 1975. Heat modeled and painted thermoplastic, c. 15x12 cm (each), Artist's collection.

Pequenas Esculturas is a series of small sized sculptures made of heat modeled GPPS containers. There are 27 known sculptures divided into two sets, 18 of them belonging to the artist's personal collection (presented by this case study) whereas 9 pieces are part of the Fundação de Serralves collection (Porto, Portugal). A total of 21 sculptures are painted.

Ângelo de Sousa softened and modeled yogurt and butter pots using a heat source, and letting them take the form of what he referred to as "ears". The series presents, in some cases, signs of flaking of the paint layers as well as yellowing of the plastic surface.

Ângelo de Sousa's Material Archive and Creative Process

Containers found in Ângelo de Sousa's studio.

Corona® infrared heater found in Ângelo de Sousa's studio.

Robbialac® cellulosic paint found in Ângelo de Sousa's studio.

Ângelo cherished his creative freedom. This could only be possible if the artist had different materials in large quantities. Therefore he assembled a large material archive in his studio [1].

For making the sculptural set *Pequenas Esculturas*, Ângelo collected unmodeled containers. There is no record of the manufacturing process of these sculptures, however, some heat sources like a 1998 infrared heater, which could be an upgrade for what he had previously owned [1], can be found in his studio. Other hypothetical heat sources were found in Ângelo's studio, like a fireplace the artist claims to have used [2], and a tiled stove suggested by his son [3].

Likewise, he also stored cans of industrial cellulosic based paints and airbrushes which may have been used to paint the sculptures [2], as they match the identified paint.

Reproduction of the Heat Modeling Process

Reproduction of the three proposed heat modeling processes

Ângelo de Sousa created *Pequenas Esculturas* using heat. Being a thermoplastic, the GPPS containers change their shape after a few seconds when heat is applied (about 75ºC). To comprehend the production process, the potential heat sources were tested:

1- Infrared electric heater (in front of it)
2- Fireplace (inside of it)
3- Tiled stove (on top of it) **

The reproductions that were produced on a fireplace show burned areas, which none of the sculptures exhibits. In the tiled stove the reproductions have been difficult to model. The infrared electric heater has been the one to offer the closest results to the appearance of the original set.

** Reproduction with a metal plate over fire.

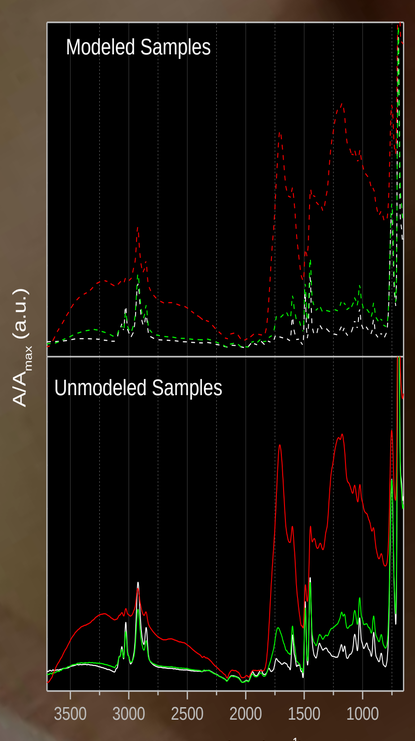
Investigation of aged GPPS

Despite *Pequenas Esculturas'*s relatively stable condition, there is no long term prediction for the evolution of the degradation processes identified in this research. For that matter a study on the photooxidation (visually detected by strong yellowing) of unmodeled and modeled GPPS through accelerated ageing was undertaken, using Infrared and Fibre Optics Reflectance Spectroscopies to better evaluate the set's condition as well as to monitor it in the near future.

New GPPS heat modeled and unmodeled samples were artificially aged under a Xe-arc lamp (λ >300nm). Visual changes were detected after 120 hours.

FTIR-ATR spectra analysis of both types of samples show formation of hydroxyl and carbonyl groups. The comparison of the spectra suggests that while unmodeled samples upon degradation first form carbonyl species at 120 hours, hydroxyl groups are the first new species identified in degraded modeled samples, already after 48 hours. The formation of these species was observed in the artist's naturally aged reference containers as well.

The reflectance spectra obtained for both unmodeled and modeled samples show a new band at higher wavelengths, revealing the formation of new chromophores since the early degradation steps.



ATR-FTIR spectra of unaged and artificially aged samples.

FORS spectra of unaged and artificially aged samples.

White line- 0 hours; Green line- 120 hours; Red line- 675 hours.

Conclusions

- **With no similar art pieces in Portugal exploring the shaping of industrial plastic materials, this important research uniquely combines the study of the artwork with the artist's documentation and material archive.**
- **This study contributed to the knowledge of Ângelo de Sousa's creative and production processes, as well as for the understanding of the behaviour of GPPS in *Pequenas Esculturas*.**
- **As revealed by infrared spectra, chemical changes in modeled GPPS are occuring even when not seen by the naked eye.**
- **ATR-FTIR and FORS are powerful tools to monitor the evolution of GPPS degradation processes, leading to the formation of new carbonyl and hydroxyl groups, as well as other new chromophores (possibly conjugated C=C bonds) with the consequent yellowing.**
- **With the data obtained so far Ângelo's production of *Pequenas Esculturas* series does not seem to be accelerating the photooxidation process. Mechanical testing will be fundamental to further assess this hypotesis.**
- **The next step will be the study of adequate preventive conservation measures in order to extend the life span of these artworks.**

References

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