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Analysis of the Barbie Case Study: Social, Material and Technological Evolution Related to the Development of the Product

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Abstract

The research presented is focused on the study of the Barbie phenomenon through the historical evolution that links social development to materials and technologies development. The appearance of Barbie on the market, on March 9th 1959, a few years after the first showing of Lolita, seemed to provoke a strong breakthrough in social practices related to childhood. In opposition her birth is the result of the proactive idea of Ms. Ruth Handler to create a new female model, with which her daughter and all the other girls could identify. This new female model was opposed to the idea of mother/housewife spread by the best-selling toys of the time. Over the years, Barbie has been able to evolve following social developments, thanks to the support of technological and material innovations. As witnessed by the case study of the "Belly Button" Barbie of the 2000s. The special attention of those years addressed to the abdomen in the fashion world and the use of a new rubbery and flexible material, for the torso (which hides a joint) has allowed the creation of a barbie with the bust in a single block and of a single material, but with an astounding ability to twist. The strong interpenetration of these two aspects has created a product of great commercial success as demonstrated by the significant increase in sales too [1].

Keywords: Barbie, Design, Innovation, Materials, Technology.

Acknowledgments: Thanks to the Dr. Antonio Russo, DCCI (Doll Collectors Club Italy) president, for allowing us to study 12 models of his Barbie collection.

Forewords

The work presented is aimed to reconstruct the evolution and development of a successful product: the “Barbie”. Barbie is one of the most long-lived designed products of all time. In fact it was born in 1959 by an idea of Ruth and Elliot Handler and still lives today.

In particular the aim is to understand the interconnections between the social, material and technological aspects that over the years have driven the development of the Barbie doll. For the social analysis there is a study of the historical events and changes that have influenced the aesthetic and appearance of Barbie. For the Barbie materials and technologies analysis, instead, there is the study of shape, components and assembly and a physico-chemical characterization analysis made using specific tools [2, 3].

Figure 1. *Barbie Models Studied*

Social, Material and Technological Evolution of Barbie

The Barbie doll was born on March 9th, 1959, by the cooperation between Ruth and Elliot Handler and Harold Matt Matson, it was presented during the toy fair of New York. Just for the first year 351.000 units of Barbie dolls were sold.

Just to give an idea of its high level of success, it is necessary to provide some data related to the size of this phenomenon:

- •1 billion are the clothes produced for Barbie since 1959.
- •180 million meters of fabric used for its clothes.
- •1 hundred people between designers, model makers, stylist and seamstresses work to create a single look for Barbie.
- •3 Barbie sold every second in the world.

Considering the relevance of this phenomenon, the aim of the research is to analyze the parallel evolution of materials, technologies and social aspects related to the Barbie doll development, understanding the reasons that have allowed it to keep its success over the years. 12 Barbie's from 1959 to 2013 have been selected and analyzed (Figure 1).

It has been possible to observe, over the years, different technical and structural evolutions. The hands from tapered and closed become bigger and with open fingers, the calf becomes progressively thinner, the bust from filled and stiff at the beginning of the 60s becomes movable at the end of the 60s, using an oblique cut and a joint. This cut will be horizontal in the 80s and it will disappear in the year 2000 with the introduction of an abdomen made of silicon rubber(which hides a joint), a material that has allowed to create a "true belly" for Barbie with a bust in a single block, but with an astounding ability to twist. In the year 2013 there will be, instead, a great regression. For example the abdomen returns static while the holes for the earrings are not present in every model due to the economic crisis [4, 5].

Figure 2. *From Left Side, Barbie Vintage, Barbie TNT and Barbie Belly Button*

Among the models analyzed, three are the Barbie's that are the most significant and revolutionary (Figure 2): Barbie Vintage (1959), Barbie Twist and Turn (1966/1970), Barbie Belly Button (2000).

Barbie Vintage (1959), the first model commercialized by Mattel, has a body that is sculptured and looks like a "Lady". Its material, analyzed with the physico-chemical characterization tools (Figures 3, 4, 5), is Polyvinyl Chloride (PVC) plasticized. This Barbie identifies exactly the image of the woman of those years, for the aesthetic standards and culture of that time. Its appearance is influenced by the concept of the housewife woman and by the aesthetic canons of beauty of Marilyn Monroe.

Figure 3. *DSC Thermogram Barbie Vintage, 1959*

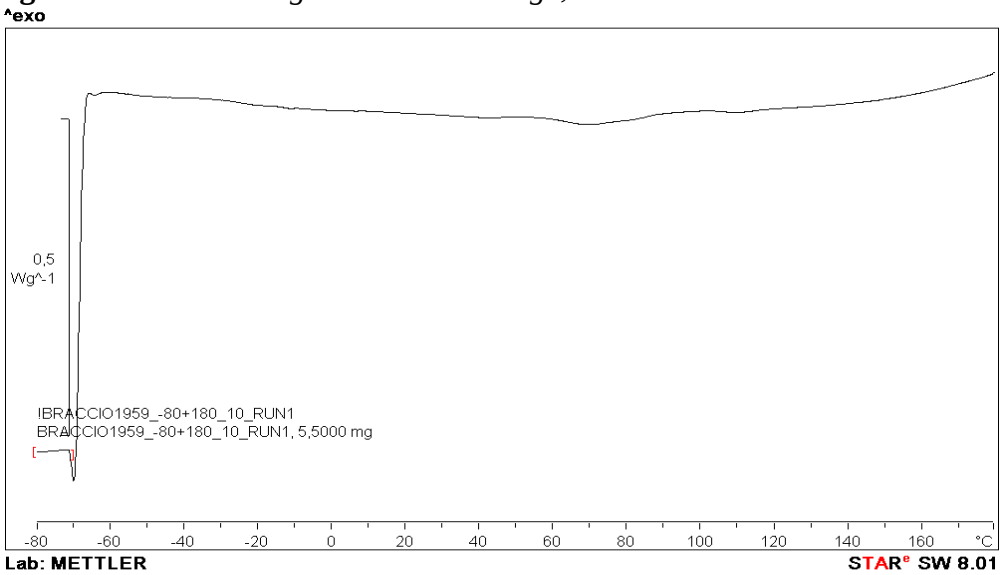


Figure 4. *Raman Spectra Barbie Vintage, 1959*

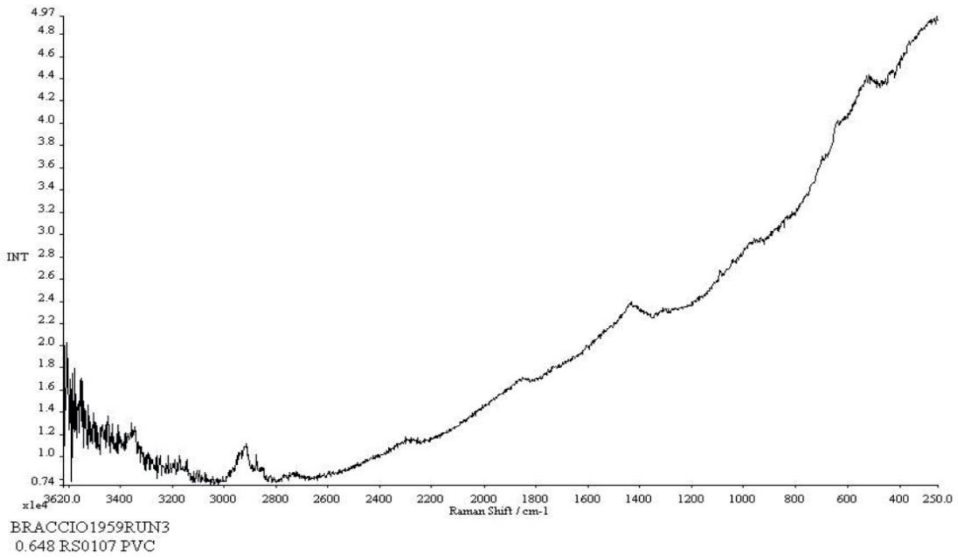
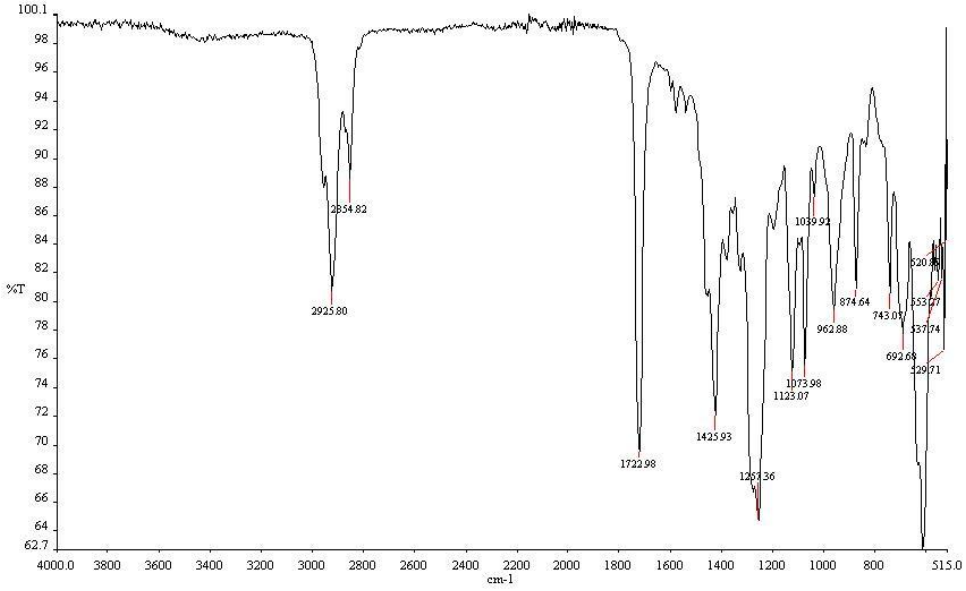


Figure 5. *FT-IR Spectra Barbie Vintage, 1959*



1959. PVC PLASTICIZED
FT-IR 12.07.13

Barbie Twist and Turn (1966/1970), also called Barbie TNT, reflects a huge change that was occurring in those years. For the first time there are the miniskirts of Mary Quant, the focus of attention moves on young people, the women become more emancipated and the twist dance is spreading. Barbie changes and through the first campaign of toy scrapping, Mattel invites the girls to bring back to the shop the old dolls, to receive by 1.5 dollars a new Barbie, made of polyvinyl chloride (Figures 6, 7, 8), with an oblique cut and a joint that allows it to move the bust and dancing the "Twist" [4].

Figure 6. *DSC Thermogram Barbie Twist and Turn, 1966/1970*

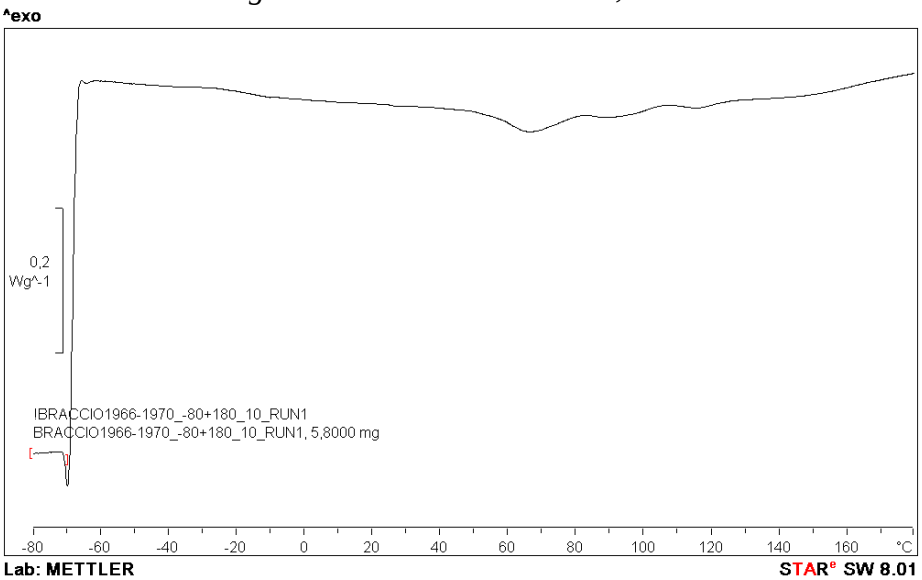


Figure 7. *Raman Spectra Barbie Twist and Turn, 1966/1970*

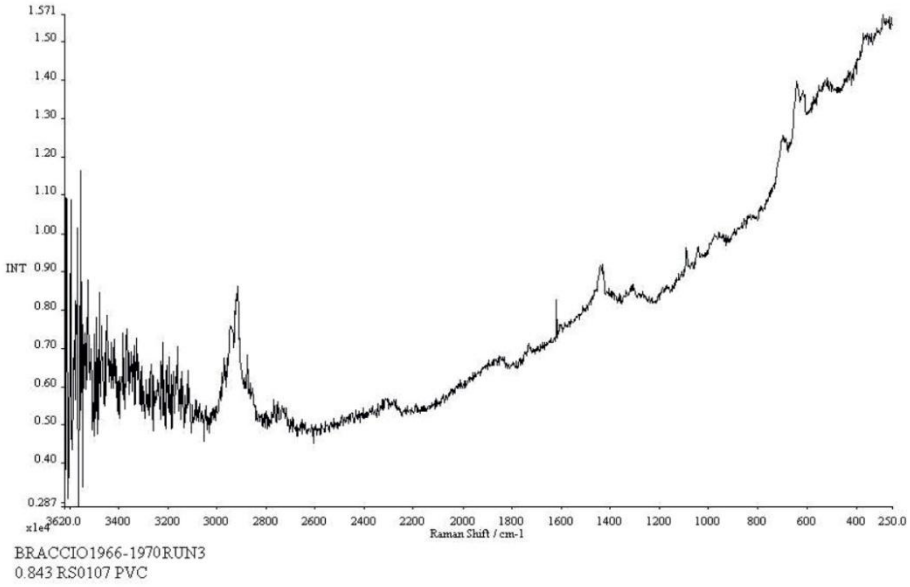
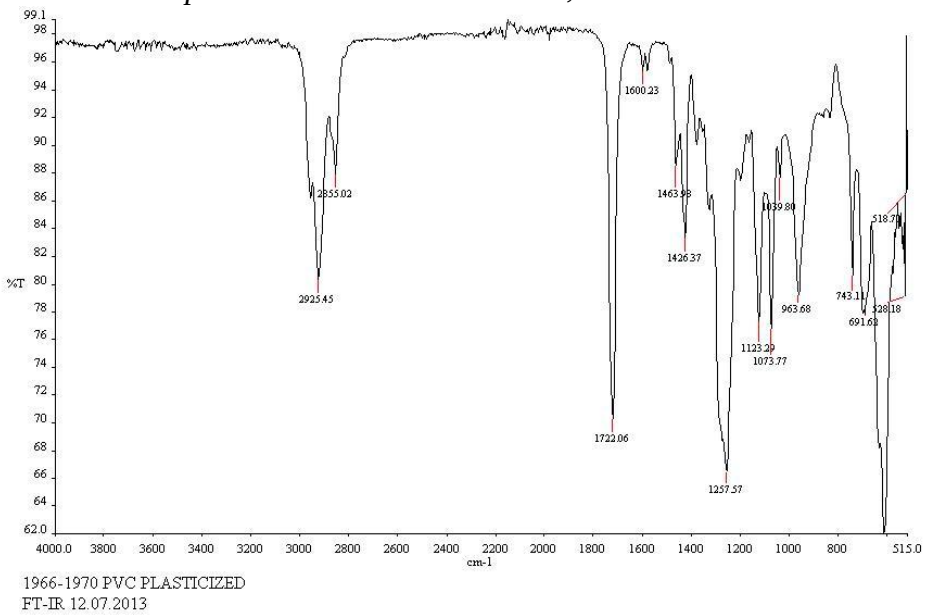


Figure 8. *FT-IR Spectra Barbie Twist and Turn, 1966/1970*



Barbie Belly Button (2000) represents the greatest and highest performing change of Barbie during the last years, with the introduction of an abdomen made of silicon rubber (Figures 9, 10, 11), which hides a joint. A material that has allowed to create a "true belly" for Barbie with a bust in a single block, that can rotate and bend sideways too. For this model there is also the introduction of the navel [7].

Figure 9. *DSC Thermogram Barbie Belly Button, 2000*

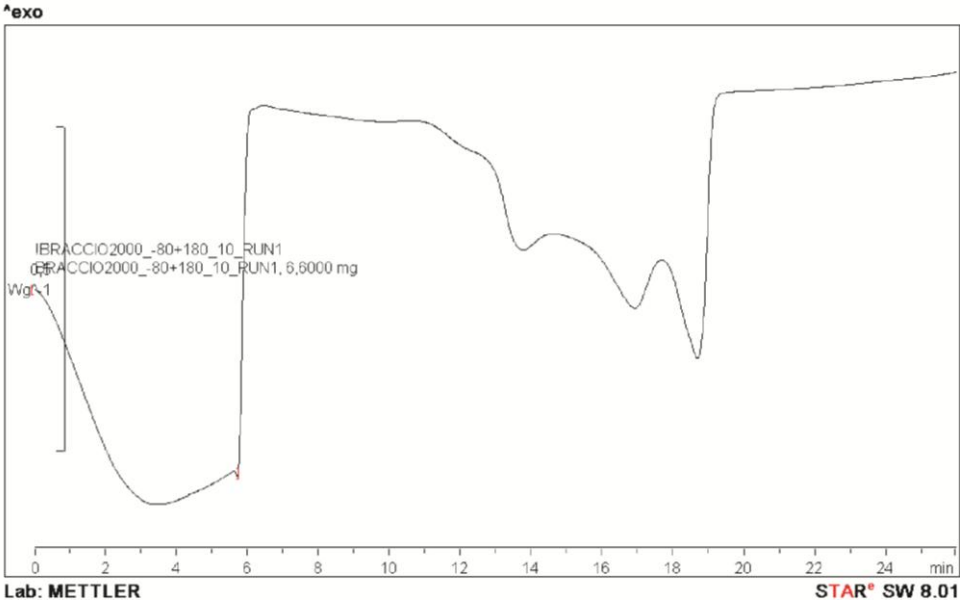


Figure 10. *Raman Spectra Barbie Belly Button, 2000*

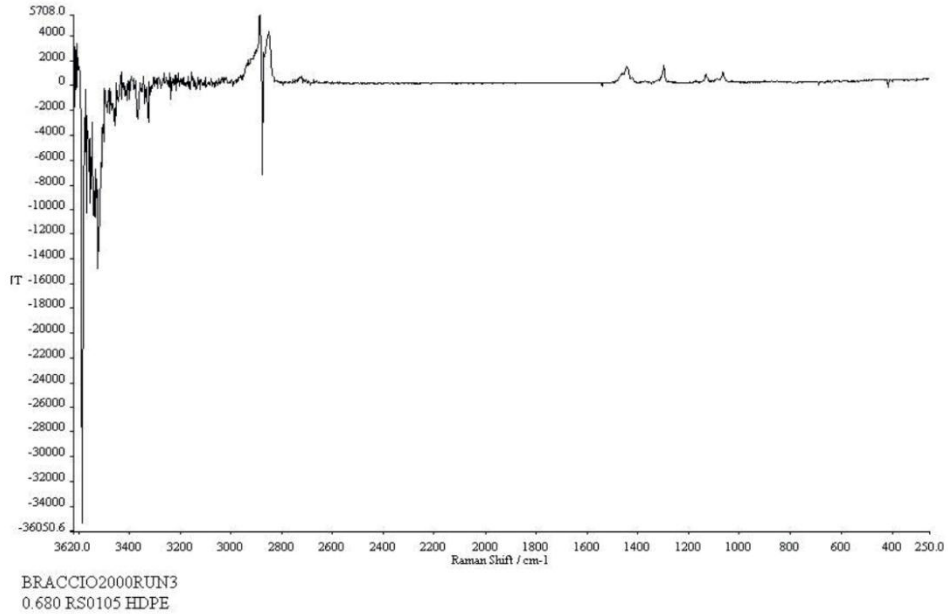
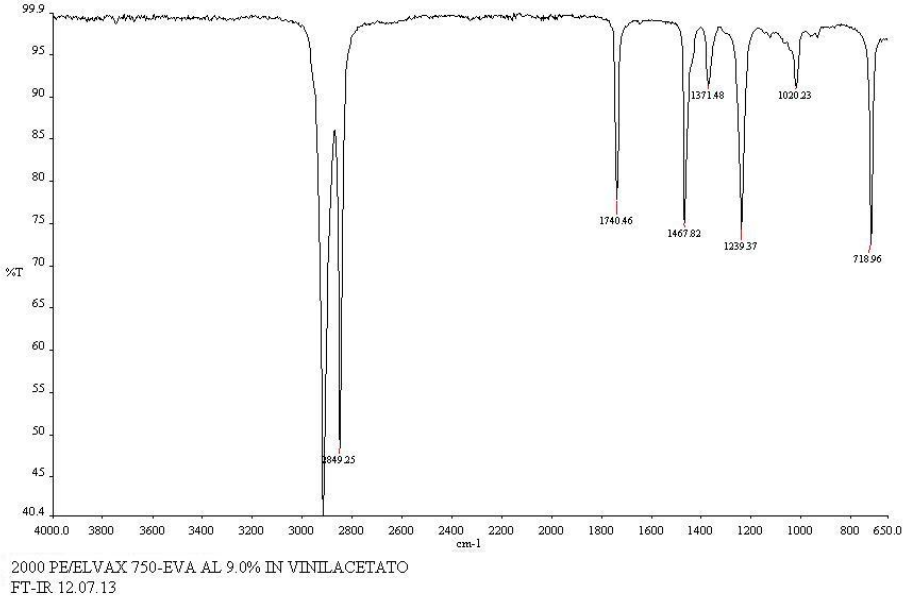


Figure 11. *FT-IR Spectra Barbie Belly Button, 2000*



After these three significant models and more than 40 years of development and innovations, during the year 2004 Mattel suffered the effects of the economic crisis because of the appearance on the market of the Bratz dolls. For this reason in order to get lower prices, the quality of the product becomes lower. In the year 2013 for example with Barbie Wave Chic (Polyethylene Vinyl Acetate, PEVA) there is the use of a low quality nylon for the hair and the body loses its technical performances. The bust, although empty, becomes static and the only possible movements are related to the arts (vertically) and the head (horizontally).

Tools and Methods Used for the Physico-Chemical Characterization of Materials

For the Barbie materials and technologies analysis there is a study of shape, components and assembly and a physico-chemical characterization analysis of the materials used.

In particular for the physico-chemical analysis three specific tools have been used: DSC822 Mettler Toledo, RamanFlex 400F Perkin Elmer and Spectrum100 FT-IR Spectrometer Perkin Elmer.

The DSC (Differential Scanning Calorimetry) is a tool that allows us to understand the materials physico-chemical behavior. This tool allows us to know some properties of a material such as specific heat, glass transition temperature and melting temperature. In particular its functioning relies on tests based on a controlled heating or cooling of the sample under examination and measuring the difference between the thermal flows of analyzed sample and reference sample (empty pan). For the material characterization of each

Barbie model a very small portion of material (6/10 mg) has been taken from the right side of the shoulder (Figure 12). Each sample has been analyzed planning a test with an increase in temperature (10K/min) from 193,15K to 453,15K, the choice of the test settings has been aimed to cover the temperature range of physico-chemical reactions of polymers. At the end of the test the results on the diagram show the temperature range in which the material reacts, allowing to characterize and identify the type of polymer.

The RAMANFLEX is a tool for the identification and the analysis of molecular types. Raman spectroscopy is the result of the dispersion of the light. The radiation can be resiliently scattered without any variation of its wavelength (Rayleigh scattering), or it can be inelastically scattered, producing the consequent Raman Effect. There are two types of raman transitions: "Stokes radiation" (the photon collides with a molecule and loses some energy) and "anti-Stokes radiation" (the photon collides with a molecule and gains energy). Both "Stokes" and "anti-Stokes" radiations consist of lines that correspond to molecular vibrations of the substance in the analysis. Every compound is characterized by its own and unique Raman spectrum, which can be used as a sort of digital fingerprint for the identification. For the material characterization of each Barbie model the raman laser has been pointed on the right shoulder after its cleaning with a special cloth. At the end of the test the results on the diagram show the "fingerprint" of the molecular type allowing, the aid of a raman spectra database, to characterize and identify the type of polymer.

The FT-IR is another tool for the identification and the analysis of molecular types, it is a spectroscopic technique of absorption that studies the chemical bonds. It gives information on two kinds of peaks, respectively related to functional groups and "fingerprints". For the materials characterization of each Barbie model a small portion of material has been taken from the right shoulder (Figure 12) and has been analyzed. The fingerprint peaks are unique and different for each molecule and therefore they allow to characterize and identify the material.

At the end the data of three characterization analysis have been compared to get accurate information for each Barbie model, reconstructing the materials evolution related to the development of the product (Table 1) [6].

Figure 12. *Material Sampling*

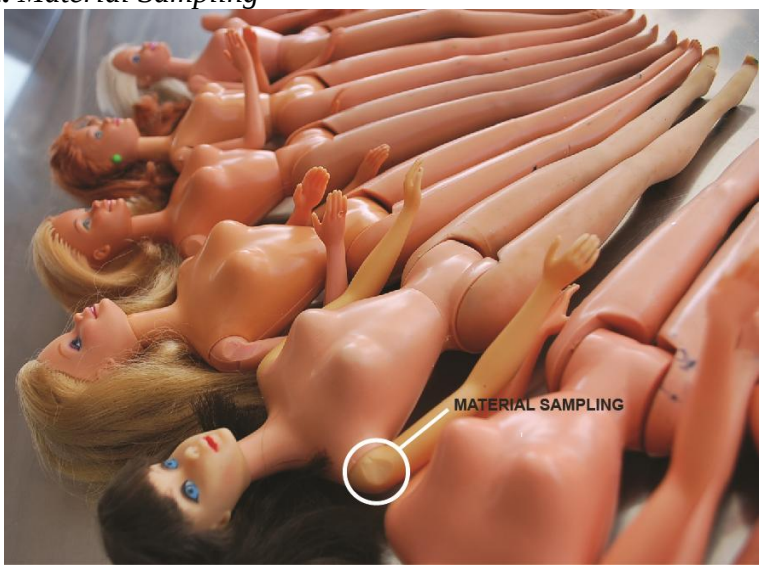


Table 1. *The Materials of Barbie Analyzed*

BARBIE	Material
1959	PVC PASTICIZED
1962-69	PVC PASTICIZED
1966-70	PVC PASTICIZED
1971	PVC PASTICIZED
1975	HDPE(HIGH DENSITY POLYETHILENE)
1983	PE
1984	PE
1993	PE
1998	ABS
2000	PEVA(POLYETHILENE VINIL ACETHATE)
2004	ABS
2013	PEVA(POLYETHILENE VINIL ACETHATE)

Conclusions

The research presented shows the complexity and the strong interconnections existing between social, material and technological aspects related to the development of a successful product. It has been made studying and analyzing the historical and social context and characterizing by a physico-chemical point of view, one by one, the material of 12 Barbie models. Over the years, the continuous development of materials and technologies allows the design to follow the social inputs. On the other hand the social and historical inputs stimulate the research for materials and technologies.

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