

# Sustainable Material Substitutes for Stop motion Puppet Exteriors

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**Abstracts:** Sustainability with the materials used for the purposes of art are a paradox which artists face; does the message brought forward by art outweigh the waste it produces? Central to this research is the production of stop motion puppet "fleshing" also known as the exterior of a stop motion puppet and the materials used to create it. It is the nature of stop motion animation to craft physical characters, props, and environments in order to animate. Vastly different from its counterpart, CGI (Computer Generated Imagery) animation, in which the entire animation is modelled digitally producing no physical waste; the single nature of stop motion animation props deters enthusiasts from pursuing the craft. In addition to this issue, materials used in stop motion animation are usually purpose built in which it serves no purpose after being used in animation. As a result, productions produce large amounts of waste post animation. It is imperative to discuss the importance of exploration in materials conventionally used in non-animation disciplines and its potential application towards stop motion animation. This research aims to find parallels in alternative material's properties to enable the use of non-specialist products and its ability to be reused.

**Keywords:** Puppet Construction, Fleshing, Substitute Material Properties.

## 1. INTRODUCTION

In the process of specialising in a field, it is natural to focus one's attention and thought flow only towards elements that serve the main purpose of the study. The niche that is stop motion animation has created pockets of information varying in region due to separate experimentation based on the availability of materials as well as the climate of the region. A material used for puppet fleshing that works well and is stable in a temperate climate, may not produce the same results in a humid subtropical climate. By observation, it would make sense to span the exploration of materials used in other fields which were designed for consistency and stability regardless of climate; materials which hold the same or similar attributes of conventional stop motion fleshing materials. In order to discover a material's properties in relation to stop motion animation puppet fleshing, an animator must first need to understand the flow of human thought processes and its relation to cross disciplinary exploration of different fields [1]. Explorations such as these require interest in related fields, but how does one identify a related field when it comes to fleshing in stop motion animation?

As stop motion animation is a branch of animation that requires physical construction of its characters, its nature is hands-on and tactile; this form of relational knowledge between material familiarity and technical competence can also be found in the craft consumption practice of home improvement projects where materials are constantly appropriated for various functions [2]. Fields such as these have undergone rigorous testing in their respective environments to ensure that the materials used perform similarly regardless of region and climate. Stability in materials is what is needed in the construction of stop motion puppet fleshing as it eliminates the need to use purpose-built materials and borrows the technology and testing of a different field.

## 2. Stop-Motion Puppet Production

### 2.1. Material Properties for use in Art and Stop Motion for Sustainability

The process of stop motion animation is that of an educative one, in which an animator is constantly interacting with their puppet and its environment while navigating real-world physics [3]. Enthusiasts would argue that the unique charm and handmade quality of stop motion animation is worth the labour-intensive nature of the craft. It is this process of understanding problems as they arise and quick-witted problem solving that shapes and forms a

stop motion animator to further understand their craft and develop different approaches based on the challenges faced. Sustainability has long been a re-curring theme in art, whether it be at the forefront or as a requirement in the process. Understanding the different functionalities of materials and their properties garner ethical awareness within artists, who can create art while respecting the values of sustainable development [4]

Frequently artists are so driven by their message that they search for mediums that will successfully convey their message without taking into consideration their carbon footprint. An example of a successful message brought forward with the use of a non-sustainable yet repurposed material would be that of artist Mikey Please and his 2013 stop motion film "Marilyn Myller". Material used in Please's film was Styrofoam, for both the environment and fleshing of the puppet [5]. A repurposed material, it fits the criteria of using a material used for packaging to be utilised as fleshing. The Styrofoam lent a translucent quality that allows light to pass through in scenes where Please used a light painting technique for cinematic quality, yet different densities were used to cover the puppets armature which allowed for consistent aesthetics throughout the film. Examples such as these are chosen to bring forth that the repurposing of material should not be the only criteria for identifying parallel materials, but also its contribution to waste post production. If these issues are not taken into account, this study and its efforts would not be effective.

## **2.2. Exploration of Alternative Materials**

The definition of waste in the context of this research can be split into two perspectives; financial waste as well as the physical waste of materials. Understanding the life cycle of a material and its applications ensures that designers make the optimum choice when it comes to the use and reuse of materials needed for their projects [6]. Viewed from the angle of financial waste, being able to repurpose unused materials from a project would benefit an artist in terms of cost. When a material is repurposed for the use of art, its functionality after the completion of the artwork does not go to waste as it can be utilised for its initial function. The inability to reuse specialist-built materials result in physical waste and a negative impact on sustainability and the green initiative.

Sustainable in the context of this research would be referring to the use of pre-existing materials in order to lessen the production and use of specialist grade materials that may not be available for use to the smaller scale animator. In large scale productions, model replacement libraries are often used to allow for a robust articulation and expressiveness of a stop-motion puppet albeit it can potentially incur high production costs, especially with clay libraries. Alternative methods of replacement library models have been proposed to mitigate the issue through the use of 3D printing or digital fabrication technology [7]. However, to an individual, small scale animator, this would require additional and possibly lengthy learning and acquisition of skills or even a lack of affordable accessibility [8]. As it is inevitable that materials must be used for the purposes of animating, it may be more prudent to the small-scale animator if the materials could be sourced from non-conventional animation fields, which would have properties that equal their specialist grade counterparts.

Reuse is an additional perk to this method as to reduce the single-use nature of the material [9]. It is natural for a new artist or animator to explore the materials available to them in the formation of their art. During the process of investigation within its trial and error, sustainability often becomes the byproduct effect as the need to find new uses of existing materials is borne by the saving of cost. Faced with the lack of financial resources or material availability, digital substitution often becomes an option. Although the method of digital substitution may contribute to the lesser cost of physical materials, access to software proficiency as well as technically skilled individuals and their rates of service will inadvertently incur its own cost. Issues such as these are the driving force towards the importance of alternative material exploration conducted by the animator themselves.

## **3. Breakdown of stop motion puppet exterior (Fleshing)**

A stop motion puppet can be broken down into several layers to its construction; Interior Structure, "Bones"/ Rigid sections, Joints, and Exterior Skin also known as Fleshing. The interior armature, consisting of a sturdy bone structure working in tandem with Rigid Sections and joints to support the weight of the puppet and its build up materials. Fleshing is a term used in stop motion animation referring to the exterior "flesh" portion of an armature

puppet. A portion of a puppet that sits on the puppet armature that makes up the aesthetics of the puppet. Materials for fleshing vary depending on the aesthetic chosen for the character, ideally the fleshing should cover all interior structures as to not interfere with the illusion of the character existing in its own universe as opposed to being a product within our own world (unless that is what is called for in the theme and story of the animation).

Specialist materials have been developed for fleshing in order for it to work to the animators' advantage, in which it delivers the aesthetic quality and durability to be handled for animation. The cost of these specialist materials and its non-biodegradability, contributes to a large amount of waste produced every time a stop motion animation is produced. Everything from failed testing stages to post-production waste is taken into account. An example is the process of puppet skin casting, a final stage process in which a puppet armature is placed within a plaster mould to coat the armature with silicone skin encasing it to become the final character form before costuming. A large majority of materials used during this process is not sustainable as the only reusable item would be the mould unless it is damaged or broken during casting.

A stop motion puppet varies in terms of aesthetics based on the animation genre it is created for. Thankfully due to this, the spectrum of possibilities when it comes to the fleshing of a puppet broadens though it should still hold similar characteristics in terms of function [10]. An example would be the comparison of puppets used in Kirsten Lepore's "Move Mountain" from 2013, which consisted of cast silicone fleshing, to Adeena Grubb's use of less skin-like materials namely fabric and feathers in her stop motion animations. While both animators created their puppets from different materials, this did not affect the storyline as the final product did not hinder the functionality of the puppet.



**Fig. 1.** Puppet from "Move Mountain" by Kirsten Lepore (2013)

A particularly interesting technical execution on the puppet by Lepore, the effect of claymation was achieved by creating a cast that had the deliberate imperfections such as finger indents and uneven texture but was cast in silicone to provide the puppet with a durable and reusable quality [11]. The balance between aesthetic and function is important to note here as it displays the thought process in problem solving when it comes to developing the skin of a stop motion puppet.

Observation of this film denotes that durability is one of the main characteristics that should be a part of stop motion puppet flesh construction. A puppet is expected to endure constant repositioning and handling [12], as well as interaction with terrain and props, while the use of clay in this film would not be impossible, the nature of the material to pick up dirt and deform will ultimately cause inconsistencies within the animation and affect its production quality. Although clay is categorised as a "specialist" material and available in art stores, in this case it was replaced with a material that can be borrowed from a "non-specialist" supply store and further tested to gauge its functionality in different situations.

In contrast to the puppet produced by Lepore, the puppet fleshing shown in Figure 2 is from the animator Adeena Grubb, who has used fabric as the exterior of her puppets [13]. The technique developed by Grubb lends a warm nature to the aesthetic of her puppets, yet still retains its functionality. The thought process of the construction of Grubb's puppet fleshing with the use of fabric as the exterior can be analysed further with the identification of her material functional needs. Observation of her process shows the application of adhesive materials to the fabric, testing in fabric flexibility, and the ability to paint the finished product.



**Fig. 2.** Puppet with fabric exterior by Adeena Grubb

An important observation to be made here is that both Lepore and Grubb are utilising the method of stop motion animation called “replacement animation” in which multiple replacement parts of a puppet are changed out between frames to depict the illusion of movement [14]. For example, the eyelids on Grubb's puppet are part of a set of eyelids that are shot in succession and emulate the look of the puppets' eyes opening. The different subsets in terms of techniques for stop motion animation enables the animator to pivot based on the aesthetic and functions of the puppets fleshing.

#### **4. EXAMINATION AND TAXONOMY OF MATERIALS**

Commonly used materials for the fleshing of industry grade stop motion puppets are special effects silicone, foam latex, or even 3D printing technology [7]. Each of these components come with their drawbacks ranging from access to learning curve. Another frequently used flesh material is clay and its many variants in terms of curing. The appeal of clay in stop motion lies in its pliability, handmade look, and texture [15]. Although clay is considered one of the most accessible fleshing materials for beginners, it comes with a myriad of drawbacks including constant clean up, accidental denting from mishandling and the like. The fundamental goal of stop motion is to create the illusion of life with inanimate objects, inconsistencies caused by unstable materials that show proof of handling by animators, breaks the illusion, rendering the material into a “difficult to animate” category due to its issues.

As it is defined that the fleshing of a puppet is heavily reliant on its function and the technique of stop motion animation used, the next step to be taken is the examination and taxonomy of materials. The fields that are to be cross examined here are that of home improvement, relating to hardware store items repurposed for fleshing material. This field was chosen not only because it is a field most individuals are regularly exposed to therefore familiar with, but also due to the consistency of the materials performance as it serves its purpose of fixing household items and are required to yield the same if not similar results regardless of region as most of these products are mass produced. The framework deployed is that of action research due to its testing and analysis phases to find parallels between materials used in home improvement and stop motion animation.

The journey of analysis for these parallels begins with determining the characteristic of the materials that is integral to its performance. For example, if a flesh material is required to bend and stretch whilst still retaining its original form when set to a neutral position as well as have a reasonable workability time to be moulded into either a cast or shape; its counterpart would be of the category of silicones used for caulking. The established stop motion industry uses a compound which contains silicone that behaves similarly but was modified to fit animators' requirements for puppet making and branded as Dragonskin by Smooth-On, this brand produces artist grade silicone specifically for puppet flesh and special effects. Once the component is identified, it is then cross analysed with pre-existing techniques used in art craft such as the use of silicone to make moulds.

A technique called Oogoo also known as Proto-putty, was first developed by the arts and crafts community by combining a hardware store RTV silicone with the household kitchen item, cornstarch to create a mouldable silicone putty. The initial use of Oogoo included making at-home moulds to recreate trinkets out of resin by imprinting the negatives of the item into the putty, waiting for it to cure, then creating a duplicate out of resin. The stop motion community took heed to this technique as it produced a putty that could cover the joints of their puppets as well as create faces that could deform and return back to its original form, like skin.

It is the hope that with the record and tabulation of data, animators can create a database of tested methods and the results yielded from it. Information tables such as these can be shared amongst the community of stop motion animators to bridge the gap of knowledge regarding materials for puppet fleshing.



**Fig. 3.** Cast of puppet limb using Oogoo (Proto-putty) technique.

## 5. Result

By observation of the two case studies mentioned above, taking note of their methods, techniques as well as failures, the authors were able to devise an investigation on identifying materials for substitution. The investigation was borne from the authors inability to obtain workable industry grade material for the task at hand. Issues that arose from situations like these proved that even when cost efficiency is not the priority, roadblocks such as the material being unavailable in terms of shipping overseas also contributed to the obstruction in research. While tutorials and material lists are provided by stop motion communities online, during testing the authors experienced a sizeable variation in results due to regional environment issues such as humidity, temperature, and name brand variations.

Observations during testing such as these led to the author analysing and breaking down the chemical components needed instead of their industry grade name brand counterparts.

### 5.1. Oogoo/Proto Putty

Experimentation with Oogoo yielded a spectrum of results due to its variable, corn- starch, and the quantities that were combined with Acetic cure silicone. Noted from the authors research findings was the use of Acetic cure silicone and not neutral cure or 100% silicone. Testing proved that only the use of acetic cure silicone, a chemical cure- based silicone, yielded the ideal consistency for cast or modeled fleshing. The result was a putty-like consistency that had a 5-minute work time to partial cure and an ability to adhere to uncured additions. The variable cornstarch determined the rigidity and the work time of the putty, spanning from very soft to hard rubber like material, and the more cornstarch ratio to the putty the less work time to full final cure.

### 5.2. Medical Fabric Tape

Included in the realm of fleshing is skin, the final exterior of a puppet. While Oo- goo/Proto-putty drew results that would make it successful for both flesh and skin, fab- ric texture lends a completely different aesthetic to the puppet exterior and doubles as use for costuming in addition to skin. As cloth movement in stop motion is scaled down, the texture and weave of cloth needs to match the size of the puppet. Medical fabric tape not only mimics the miniaturized texture of real-scale cloth texture but has the convenient adhesive quality without worry of visible glue lines. Its ability to be coated with paint and thin penetrable nature allows it to be sewn alike to its fabric counterpart to further add to the final aesthetic.

Figure 4 is a visualisation of the identification and performance record conducted during testing to discover parallel materials from home improvement hardware stores. The characteristics contained in the table are the baseline requirements for functionality of stop motion puppet fleshing material.

Industry Grade Counter-part	Parallel Material	Fleshing Technique	Characteristic / Function			
			Flexibil-ity	Elasticity	Rigidity	Customi-zable: Col-our/Paint
Foam Latex Casting	Medical Fabric Tape	Wrapping	Y	Y	N	Y
Industry Grade Counter-part	Parallel Material	Fleshing Technique	Characteristic / Function			
			Flexibil-ity	Elasticity	Rigidity	Customi-zable: Col-our/Paint
Foam Latex Casting, Silicone Casting	Oogoo/ Proto Putty	Mould Cast/Form- ing	Y	Y	Depending on cornstarch ratio	Colour:Y (During mixing phase) Paint: N

Fig. 4. Parallel Material Analysis

## 6. REFLECTIONS AND DISCUSSIONS

It is in hopes of this research that stop motion animators are encouraged to research alternate materials and

their properties in relation to puppet fleshing in order to aid in the participation of new animators to the field. The essence of this thought process is to prioritise the function of the material and its sustainability as to reduce waste after production, and to take into consideration that parallels can be found based on analysing the purpose-built speciality materials. Split into two criteria, this approach to resource efficiency can be viewed in terms of financial and physical waste. Optimization need not only be that of one criterion, but can span both.

Results yielded from the Oogoo/Proto-Putty experiments when compared with the industry grade counterpart highlighted issues with the waste produced from unused materials post-project completion. Although both the Oogoo and industry grade puppet skin material both shared the main component of silicone, a non-biodegradable substance, what it did contribute to the artist was the reduction of financial waste due to its availability. Industry grade puppet skin silicones like name-brand Dragonskin may be accompanied by high shipping costs and at times complete unavailability due to regional boundaries. Issues such as these arise further concern if the material fails to perform as intended due to climate differences, concluding in not only financial waste but also physical as the material cannot be reused for different purposes. The Oogoo/Proto-putty experiments provided the artist with a stable material and, more importantly, possessed incremental adaptability in problem solving. An example of financial efficiency drawn from these methods are evident in the Medical Fabric Tape experiments. Although it possesses the same biodegradability aspect as its industry counterpart, latex puppet skin, excess material left unused from a project will allow the substituted material to be reused as intended for medical purposes, therefore resulting in a more cost-efficient alternative.

After analysing the results of the Oogoo/Proto-putty and medical fabric tape results, it is important for animators and artists alike to nurture this sense of exploration and experimentation with materials in order to identify its potentialities.

Encouraging exploration and experimentation within stop motion animators promotes discourse that will add to the interest in a field that is already dwindling in interest due to its time-consuming nature and lack of community in certain regions. In terms of knowledge transfer, the crux of this research aims to birth a new outlook from both the animator and audience on how materials can be applied to different artworks spanning past stop motion animation, with fleshing being the testing ground to observe successful use. In the spirit of cross-disciplinary exploration, the preliminary outcome of this study would be strengthened further with potential collaboration with researchers especially in the field of material science to investigate material structural properties to expand sustainable solutions in artwork production.

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