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# Mechanical Engineering in Ancient Egypt, Part 49: Alabaster Products (Predynastic to Old Kingdom Periods)

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## ABSTRACT

*The evolution of mechanical engineering in ancient Egypt is investigated in this research paper through studying the manufacturing of alabaster products. Examples from historical eras between Predynastic and Old Kingdom are presented, analysed and aspects of quality and innovation are outlined in each one. Dynasty, main dimension (if known) and present location are also outlined to complete the information about each product.*

**Keywords:** *Mechanical engineering, ancient Egypt, alabaster products, predynastic to Old Kingdom Periods.*

## INTRODUCTION

This is the 49th paper in a scientific research aiming at presenting a deep insight into the history of mechanical engineering during the ancient Egyptian civilization. The paper handles the manufacturing of alabaster products during the Predynastic and Dynastic Periods of the ancient Egypt history. This work depicts the deep knowledge of ancient Egyptians of the mechanical properties of the different materials available in their society and how can they probarly select them for specific products.

Soanes (1864) in his book about the alabaster sarcophagus of King Oimeneptah I studied in details the age of the sarcophagus and presented a number of plates about the alabaster sarcophagus of the King and some scenes related to the King tomb [1]. Lilyquist (1995) in her book about Egyptian stone vessels studied the vessels features such as shapes and sizes and presented a historical summary of her catalogue items. She presented a catalogue for the stone vessels in the period between Khian and Tuthmesis IV including storage jars. Among the jars she presented was an alabaster vessel from the 13th Dynasty, alabastron from the Late Bronxe Age, alabaster vessels from Drah Abu el-Naga [2]. Klemm and Klemm (2001) studied the building stones of ancient Egypt. They described the petrography, occurrence and main application of 11 popular stone types used in ancient Egypt including the Egyptian alabaster. They showed the quarries of the Egyptian alabaster at Qawatiya, east of Minya [3].

Bevan (2003) presented some alabaster vessels from the 6th Dynasty and Late Old Kingdom [4]. Allen (2004) in her paper about miniature and model vessels in ancient Egypt presented alabaster model vessels from Giza produced during the 4th Dynasty [5]. El-Derby (2009) in his research paper about alabaster weathering,

deterioration and damage presented a description of the Egyptian alabaster in Egypt, its characteristics, weathering and damage [6]. Cross (2010) in his article about the alabaster coffin and Seti I last secret declared that the tomb of Seti I was discovered by Belzoni in the Valley of Kings on 18th October 1817 who brought the alabaster coffin of the Pharaoh to London and sold it to Sir John Soane for 2000 Sterling. He declared that the coffin length was 2.85 m long, 1.12 m width and wall thickness was between 63 and 100 mm [7]. Kuhlman (2012) in his article about the contents and significance of Egyptian alabaster jars presented a 5000 years old alabaster jar in display in the Dunham Bible Museum. She outlined that this alabaster jar represented the everyday life of Egyptians 5000 years ago [8].

Abdel Kader and Mohammed (2013) studied the restoration and conservation of Egyptian alabaster vessels from the early era in Atfiyah Museum Store at Hewan of Egypt. They outlined that alabaster vessels from Naqada I and Naqada II of ancient Egypt became one of the funeral furniture and presented an example of a Predynastic alabaster vessel in display in the British Museum. They also presented an alabaster vessel from the 3rd Dynasty in display in the Egyptian Museum at Cairo [9]. Selim, Basheer and Abdel-Hafiz (2014) outlined that a combined near surface geophysical survey conducted in archaeological site at western bank of Luxor are showed that the geophysical method offered the possibility to characterize and reconstruct the geometry of subsurface structures without destroying the deposits. Using this technique could locate an alabaster statue for Queen Tie, wife of Pharaoh Amenhotep III having 1.30 m height and 0.73 m width [10].

Hassaan (2016) in his research paper about stone vessels during the Predynastic to the Old Kingdom Period of ancient Egypt presented travertine and calcite (alabaster) bowls from the 3rd Dynasty, alabaster jar and alabaster vase of King Unas from the 5th Dynasty, alabaster vessel of Pepi I, an alabaster spouted jar and an alabaster inverted jar from the 6th Dynasty [11], Wikipedia (2017) wrote an article about alabaster and presented an alabaster jar and an alabaster perfume jar of Pharaoh Tutankhamun in display in the Egyptian Museum at Cairo [12]. Hassaan (2017) presented in two research papers a number of alabaster statues and vessels including a calcite (alabaster) gazelle statue from Naqada II, alabaster baboon statue from the 1st Dynasty, an alabaster vessel in the shape of a monkey from the 6th Dynasty, a cosmetic alabaster jar in the shape of a cat from the 12th Dynasty and an alabaster baboon headed stopper for a canopic jar from the 19th Dynasty [13,14].

## PREDYNASTIC PERIOD

The ancient Egyptians were wonderful of the Egyptian alabaster stone because of its natural beauty and its low hardness and then easy to carve. They could manufacture different products using alabaster from more than 5000 years ago including jars, beads and mace heads as will be illustrated by the following examples:

- The first example is an alabaster mace head from Naqada I/Naqada II (4000-3200 BC) and was in display for sale by Trocadero for 595 US$ and shown in Figure 1 [15]. The designer showed the mace head having a spherical shape and an all-through hole in the middle.

- The second example is an alabaster snake-jar from Naqada II (3100 BC) was in display for sale and shown in Fig.2 [16]. For better stability when hanged the ancient Egyptian mechanical designer used four-suspension holes. The jar had a rounded rim, wide opening and a slightly conical body. The white layers through the body are natural through the selection of the alabaster stone which is taking the shape of a snake giving the jar its name.

**Figure1.** *Mace head from Naqada I/II [15].*

**Figure2.** *Snake-jar from Naqada II [16]*

- The third example is alabaster beads from Naqada II – Naqada III (3650-3100 BC) in display in the Metropolitan Museum of Art at New York and shown in Fig.3 [17]. The beads have a spherical shape with all-through hole in the middle for assembly purposes..

- The fourth example is a 44 mm height alabaster mace head from Naqada III 3250-3100 BC) which was a private collection of R. Pearson from New York and shown in Fig.4 [18]. The designer gave the mace head the shape of a piriform and used the natural layers of the stone for decoration.

**Figure3.** *Beads from Naqada II-III [17].*

**Figure4.** *Mace head from Naqada III [18].*

- The fifth example is an 178 mm height alabaster jar from Naqada III – 2nd Dynasty (3200-2750 BC) sold in by Christies on 1 October 2014 in London for 32,380 US$ and shown in Fig.5 [19]. The designer designed the jar with small round rim, wide opening, short wide neck, conical body , flat medium diameter base with two vertical lug handles.. 4444

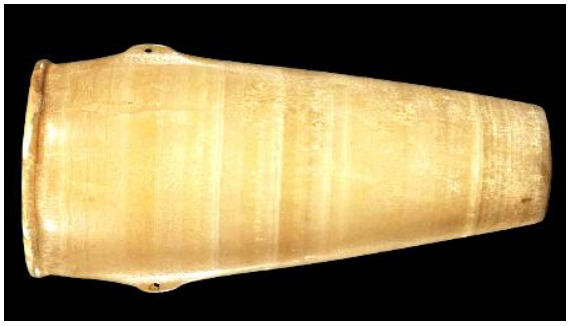

**Figure5.** *Alabaster jar from Naqada III-2nd Dynasty [19].*

## EARLY DYNASTIC

The Early Dynastic Period covers the 1st and 2nd Dynasties over a time span from 3100 to 2686 BC [20]. There is a remarkable evolution of the alabaster products industry during the Early Dynastic Period as will be illustrated through about 14 examples as follows:.

- The first example is a 176 mm height and 114 mm diameter (average) alabaster jar from the Early Dynastic Period (3100-2700 BC) in display in the Chrysler Museum of Art at Virginia and shown in Fig.6 [21]. The designer showed the jar having a slight concave surface, round rim, wide mouth and flat base having almost the maximum diameter of the jar.

- The second example is an alabaster jar from Early Dynastic-4th Dynasty Periods (3050-2513 BC) in display in the Los Angeles County Museum of Art (LACMA) and shown in Fig.7 [22]. It has an ovoid body, round rim, medium opening and flat medium base. This is most probably a Royal jar because of the symbol inscribed on the jar shoulder and zoomed in Fig.7.

- The third example is an alabaster bowl with name of Djer, the 5th King of the 1st Dynasty (3000 BC) in display in the Rijks Museum at Leiden and shown in Fig.8 [23]. The bowl had an ovoid body, wide opening, small rounded rim and large flat base. The King label was inscribed in black on the bowl shoulder.

- The fourth example is a 152.4 mm height alabaster vase from the 1st Dynasty (2865-2815 BC) displayed for sale by Goldberg Auctioneers in 2011 with estimated price of 5000-7500 US$ and shown in Fig.9 [24]. The vase had an elongated ovoid body, medium opening, round rim and a small flat base. The challenge in this design is to maintain stability of the base because of its small base which requires very professional carving to control the position of the centre of mass of the vase to be above the flat base. Otherwise it will be unstable.

**Figure6.** *Alabaster jar from Early Dynastic [21].*

**Figure7.** *Alabaster jar from Early Dynastic* [22].

**Figure8.** *Bowl from 1st Dynasty [23].*

**Figure9.** *Vase from 1st Dynasty* [24].

- The fifth example is a piriform alabaster mace head from Early Dynastic (2960-2770 BC) having 70 mm height and 60 mm maximum diameter in display in the Museum of Fine Arts at Boston and shown in Fig.10 [25]. The mace has a central hole, ovoid body and well polished surface with natural decorations.
- The sixth example is a 198 mm height alabaster jar from the Early Dynastic Period (2920-2575 BC) sold by Christies on 5 June 2014 for 18,750 US$ and shown in Fig.11 [26]. The jar has a semi-conical body with rounded shoulders, medium opening, small rounded rim and medium flat base. The decorations are natural and the surfaces are polished.

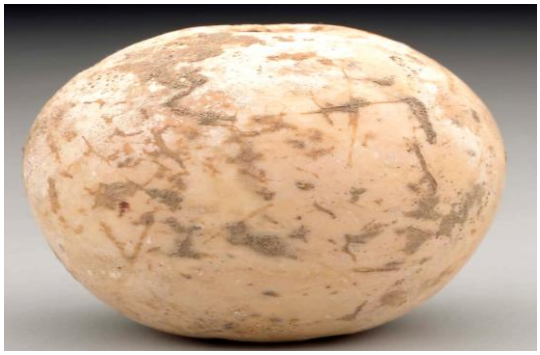

**Figure10.** *Mace head from Early Dynastic [25].*

**Figure11.** *Jar from Early Dynastic* [26].

- The seventh example is a 229 mm maximum diameter banded alabaster jar from the Early Dynastic Period (2920-2649 BC) with two lug hands sold by Christies on 11 December 2003 at New York for 38,240 US$ and shown in Fig.12 [27]. The jar had an ovoid body , wide opening, rounded rim and medium flat base. It was naturally decorated through nthe stone layers and high-class polishing.
- The eighth example is an alabaster jar from the 1st-3rd Dynasties (2920-2575 BC) sold by Christies and shown in Fig.13 [28]. It had an ovoid elongated-body, large round rim, medium opening and medium flat base. It had no handles.

**Figure12.** *Jar from Early Dynastic [27].*

**Figure13.** *Jar from 1st-3rd Dynasties* [28].

- The ninth example is an alabaster bowl inscribed with the name of Semerkhet, the 9th King of the 1st Dynasty (2920-2911 BC) in display in the National Archaeological Museum at France and shown in Fig.14 [29]. The designer showed the bowl having a parabolic body, wide opening with diameter slightly less than the maximum diameter of the bowl, round rim with body thickness diameter and a medium flat base. It was professionally carved, polished and inscribed in black. I couldn't trance any dimensions for the bowl.
- The tenth example is an alabaster vessel having a slight concave body from the Early Dynastic Period (2920-2649 BC) which was in display by Christies for sale and shown in Fig.15 [30]. It had a wide opening, round rim flashing outside the body and a big flat base. The maximum diameters are at the opening and base. I couldn't trace any dimensions for this vessel !!.

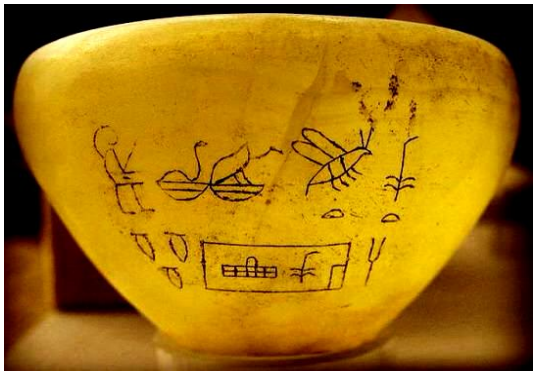

**Figure14.** *Royal bowl from 1st Dynasty [29].*

**Figure15.** *Vessel from Early Dynastic* [30].

- The eleventh example is an alabaster bowl from the 1st Dynasty (2920-2770 BC) sold by Christies on 5 December 2001 at New York for 1,998 US$ and shown in Fig.16 [31]. The bowl had a unique design where it has a hemi-spherical cavity in the middle with maximum diameter almost half the outside diameter of the bowl. There is a recess almost in the middle of the area around the cavity. The bowl height is 45 mm while its maximum diameter is 158 mm [31].
- The twelfth example is a 198 mm height alabaster jar from the 1st Dynasty-3rd Dynasty Period (2920-2575 BC) sold by Christies on 5 June 2014 at New York for 18,750 US$ and shown in Fig.17 [32]. The designer showed the jar having an elongated ovoid body, medium opening, rounded rim, short conical neck and medium flat base. He decorated the jar through the proper selection of the alabaster stone providing natural white and beige alternating layers of varying thicknesses.

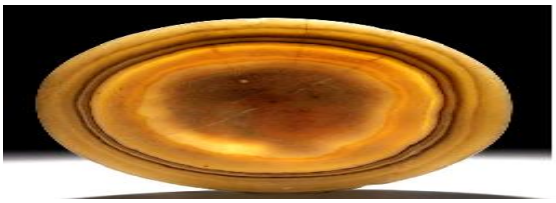

**Figure 16.** *Bowl from 1st Dynasty [31].*

**Figure17.** *Jar from 1st-3rd Dynasties* [32].

- The thirteenth and last example is a 89 mm height and 418 mm diameter shallow dish from the 2nd Dynasty (2770-2647 BC) in display in the Cleveland Museum of Art and shown in Fig.18 [33]. The dish height is only 21.3 % of its maximum diameter, the rim is flushed inward to avoid splashing and the base a medium flat surface. The designer selected natural decorations through the layer of the stone itself.

**Figure18.** *Shallow dish from 2nd Dynasty [33].*

## OLD KINGDOM

The Old Kingdom of ancient Egypt covers the 3rd through the 6th Dynasties over a time span from 2686 to 2181 BC [34]. We are with the great Kings who built the pyramids to live thousands of years. We expect those great people to achieve great evolution of the alabaster products during the Old Kingdom as will be illustrated by the many example presented below:

- The first example is an alabaster libation container for water or wine from the 3rd Dynasty (2700-2600 BC) in display in the Egyptian Museum at Cairo and shown in Fig.19 [35]. It seems that this is a large closed container for storing water of wine. The container simulates two lions standing beside each other while there was a half-cylindrical passage for liquid input. May be somewhere there are taps to discharge the liquid out of the container. I was unable to get any dimensions for the container from any information source nor from the label of the Museum which I zoomed in Fig.19 and failed to read anything out of it !!.
- The second example is a 140 mm height alabaster jar from the 4th Dynasty-6th Dynasty Period (2613-2181 BC) sold by Christies on 15 April 2015 at London for 4,056 US$ and shown in Fig.20 [36]. The jar has a medium opening, wide flat rim, elongated ovoid body and medium flat base.
- The third example is 146 mm height alabaster spouted bowl from the 4th Dynasty – n6th Dynasty Period (2600-2181 BC) sold by Christies in a sale on 1 October 2014 at London for 9,107 US$ and shown in Fig.21 [37]. The body has a hemi-spherical shape and the spout is long and integrated with the body in its top and has a U cross-section while the bowl rim is flat with rounded corners with the same thickness of the body.


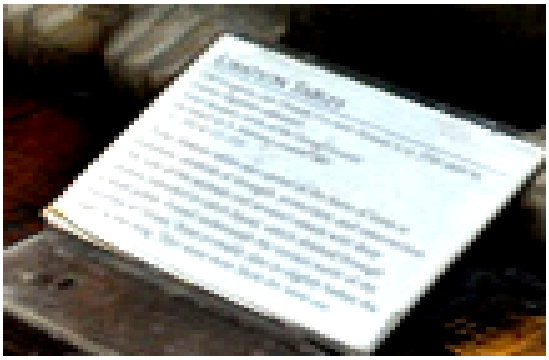

**Figure19.** *Container from 3rd Dynasty [35].*

**Figure20.** *Jar from 4th-5th Dynasties [36].*

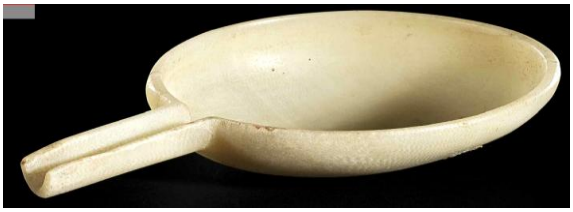

**Figure21.** *Spouted bowl from 4th-6th Dynasties* [37].

- The fourth example is an alabaster sarcophagus for Queen Hetepheres, wife of Sneferu, the 1st King of the 4th Dynasty (2600 BC) in display in the Egyptian Museum at Cairo and shown in Fig.22 [38]. The designer selected the shape of a parallelogram for his sarcophagus with flat lid. The dimensions are not assigned nor a designation label one can read and get relevant information !!.

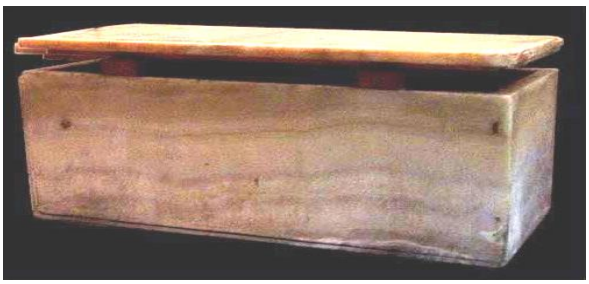

**Figure22.** *Alabaster sarcophagus from 4th Dynasty* [38].

- The fifth example is a 91 mm height and 100 mm maximum outside diameter alabaster pot stand from the 4th Dynasty (2575-2465 BC) in display in the Museum of Fine Arts at Boston and shown in Fig.23 [39]. The stand had internal and external parabolic surfaces, flat rim and medium flat base. It was used to support point-bas pots like that shown in Fig.9.
- The sixth example is a 2 m alabaster statue of Kharfa, the 4th King of the 4th Dynasty (2558-2532BC) in display in the Egyptian Museum at Cairo and shown in Fig.24 [40]. The designer showed the King setting on a chair, having a thin long beard, wearing the Nemes headdress and a short Schenti and holding an object by his right hand. No dimensions were given !!.

**Figure23.** *Pot stand from 4th Dynasty [39].*

**Figure24.** *Khafra statue from 4th Dynasty* [40].

- The seventh example is a 2 m alabaster colossal of Menkaure, the 6th King of the 4th Dynasty (2532-2503 BC) in display in the Museum of Fine Arts at Boston and shown in Fig.25 [41]. The designer showed the King in the same pose of King Khafra of Fig.24 but having a strong body. The carver could show the details of the Nemes headdress and the Cobra on its front on the forehead of the King.
- **The** eighth example is a 70 mm height and 212 mm maximum diameter alabaster bowl with re-curved rim from the 4th Dynasty – 5th Dynasty Period (2500-2400 BC) in display in the Metropolitan Museum of Art and shown in

Fig.26 [42]. It seems that the bowl has a small thickness making it a master piece in alabaster production. The designer selected an alabaster stone having natural three colored layers and a recurved rim which is difficult to achieve with highly accurate dimensions.

**Figure25.** *Menkauure colossal from 4th Dynasty [41].*

**Figure26.** *Re-curved bowl from 4th-5th Dynasties [42]*

- The ninth example is a 476.2 mm height and 222.2 mm maximum diameter alabaster vase from the 4th Dynasty (2500 BC) which was a property for James McWhirter Antiques Ltd and shown in Fig.27 [43]. The designer used an elongated ovoid body, medium opening, medium flat base and did not use any handles for it. The source called the product 'vase' while I think this is a 'jar' not a vase because simply the designer used a conical nice lid to cover the jar while a vase usually has no lid (cover) for its opening. The surfaces were carved professionally with self natural decorations from the alabaster layers themselves.
- The tenth example is a 197 mm height alabaster headrest from the 5th Dynasty – 6th Dynasty (2494-2181 BC) sold by Christies on 15 April 2015 at London for 36,875 US$ and shown in Fig.28 [44]. The designer showed the top part having a smooth-crescent shape with rounded surfaces all-around not to harm the user, a flat base (plinth) of same width as the crescent, a cylindrical capital and a fluted stem. The design simulated an architecture column. The plinth had a slight convex shape on its top.

**Figure27.** *Alabaster vase from 4th Dynasty [43].*

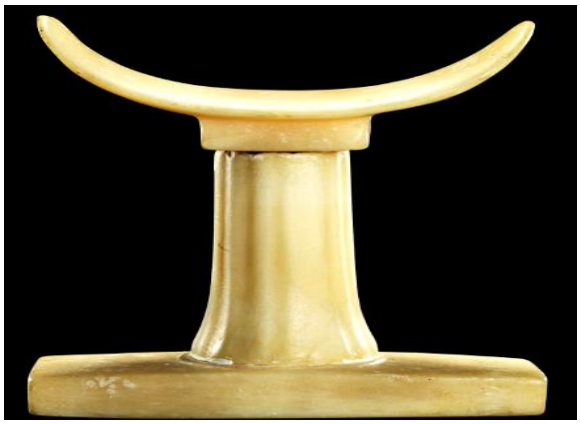

**Figure28.** *Headrest from 5th-6th Dynasties [44]*

- The eleventh example is a 118 mm height alabaster jar from the 5th Dynasty – 6th Dynasty (2450-2181 BC) sold by Christies on 1 October 2014 at London for 9,714 US$ and shown in Fig.29 [45]. The designer showed the jar having a wide moth, small round rim, elongated ovoid body, small flat base and selected the alabaster stone to provide natural decoration of the jar in the form of two brown bands with different levels of the brown color. This product requires high carving technology to maintain the stability of the product when standing on its small flat base.

- The twelfth example is a a 160 mm height and 140 mm diameter alabaster vase of Unas, the 9th King of the 5th Dynasty in display in the Louvre Museum at Paris and shown in Fig.30 [46]. This is a master pierce of the alabaster products technology in the Old Kingdom. The designer showed the vase (or jar) having a spherical body, small opening, flat rim flushed outside, small neck and small flat base. The body was decorated by inscriptions carved on the body and given a black color which required extreme profession not to damage the final product during inscriptions with almost zero error. Fig.31 shows some of the inscriptions of King Unas vase [47]. .

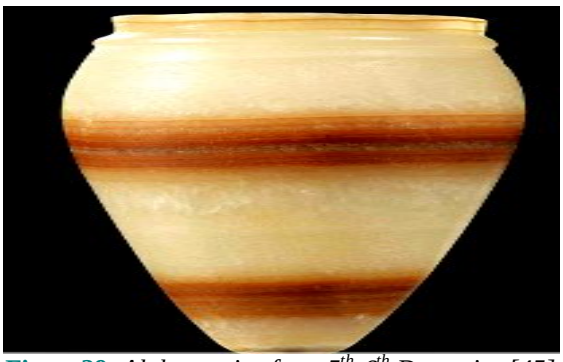

**Figure29.** *Alabaster jar from 5th-6th Dynasties [45].*

**Figure30.** *Vase from 5th Dynasty [46]*

**Figure31.** *Vase inscriptions of King Unas [47]*

- The thirteenth example is a 126 mm height libration jar from the 6th Dynasty (1245-2181 BC) sold by Christies for 37,500 US$ and shown in Fig.32 [48]. The designer used a wide circular mouth with flat rim, elongated ovoid body, medium flat base and a short spout with V-tip.
- The fourteenth example is a 372 mm height alabaster jar of Pepi I, the 3rd King of the 6th Dynasty (2331-2287 BC) in display in the Metropolitan Museum of Art and shown in Fig.33 [49]. The designer used a medium opening with rounded rim flushed outside, short cylindrical neck, elongated ovoid body and medium flat base. The jar was inscribed on the shoulder using the carving process.

**Figure32.** *Alabaster jar from 6th Dynasty[48].*

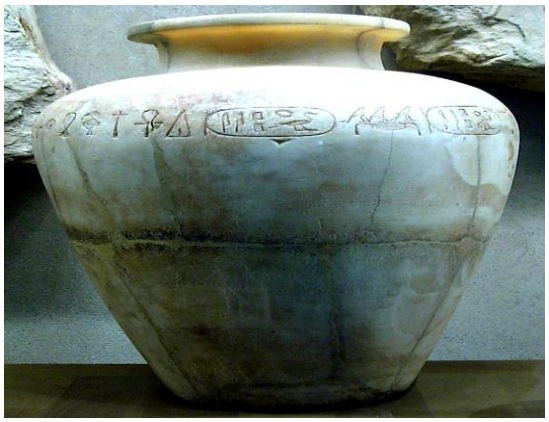

**Figure33.** *Pepi I jar from 6th Dynasty [49]*

- The fifteenth example is an alabaster jubilee vessel of King Pepi I from the 6th Dynasty (2331-2287 BC) in display in the Walters Art Museum at Baltimore and shown in Fig.34 [50]. The designer howed the jar having wide opening, wide flat rounded corers rim

flashed outside, conical body with slight concave surface and conical base met with the body through a large radius fillet. The jar body was inscribed through carving and black coloring reflecting the jubilee occasion of the King. Unfortunately, the dimensions are not available.

- The sixteenth example is a 150 mm height and 130 mm maximum diameter alabaster ointment jar of King Pepi I from the 6th Dynasty (2331-2287 BC) in display in the Metropolitan Museum of Art and shown in Fig.35 [51]. The designer is closer to that in Fig.34 with some differences: the rim and base were inlaid by a gold leaf, the rim is rounded, the bottom part of the body had less diameter and the carving quality was less than that of the jubilee jar.

**Figure34.** *Pepi I jubilee jar from 6th Dynasty[50].*

**Figure35.** *Pepi I jar from 6th Dynasty [51]*

- The seventeenth example is a 137 mm height and 120 mm diameter alabaster vessel of Pepi II, the 5th King of the 6th Dynasty (2278-2184 BC) in display in the Metropolitan Museum and shown in Fig.36 [52]. The design is almost similar to that of Pepi I in Fig.34 except the white rim and base and the inscriptions. The Egyptology experts can investigate in details how could they provide the two colors of th jar.
- The eighteenth and last example is a 173 mm height and 114 mm maximum diameter alabaster spouted-brewer of Queen Ankhenes-Pepi from reign of King Pepi II (2278-2186 BC) in display in the Metropolitan Museum of Art and shown in Fig.37 [53]. The spout had a 15 mm length and an un-assigned diameter. The designer showed the brewer having a wide opening, rounded rim with thickness diameter, conical-slight convex body, long inverted base with medium flat base. Again, the designer used two different colors for the body and base of the brewer. The long base was decorated by carved circles over the whole length.

**Figure36.** *Pepi II jar from 6th Dynasty[52].*

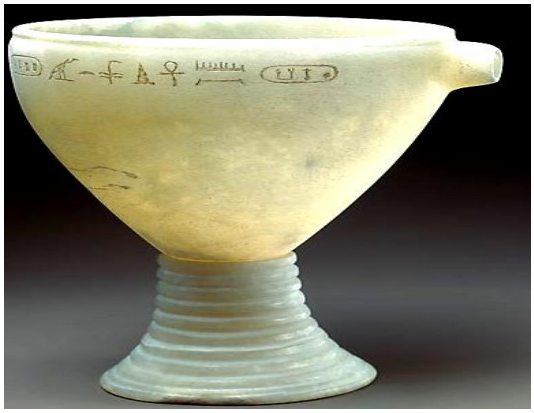

**Figure37.** *Brewer from 6th Dynasty [53]*

## CONCLUSION

- The evolution of mechanical engineering during the ancient Egypt history was investigated in this research paper through the manufacturing of alabaster products during the Period between Predynastic and Old Kingdom.
- The ancient Egyptians produced alabaster mace heads since the Naqada I – Naqada II Period.
- Alabaster jars were registered through models production since the time of Naqada II.
- Alabaster beads were registered through models production since the time of Naqada II – Naqada III.
- Alabaster jars with lug handles started to appear according to available models since the time of Naqada III.
- Remarkable evolution of the alabaster products started during the Early Dynastic Period.
- Various Royal and non-Royal products of different shapes and decorations appeared during the Early Dynastic Period.
- Among the alabaster products manufactured during the Early Dynastic Period was: jars, bowls, dishes, vases and mace heads.
- Royal alabaster products manufactured during the Early Dynastic Period were inscribed by the name of the King using the carving process and black-painted.
- The ancient Egyptians were great in all engineering aspects of the Old Kingdom.
- The alabaster products manufactured during the Old Kingdom comprised libraton container, jars, bowls, pot stands, vases, brewers, head rests, sarcophagi and statues
- They produced spouted jars during the Old Kingdom with short, medium and long spouts.
- They produced large alabaster jars during the $6^{th}$ Dynasty having up to 0.372 m height.
- The produced alabaster Royal jubilee jars during the $6^{th}$ Dynasty inscribed using the carving process and black painted.
- Alabaster products of the Old Kingdom reflected the high professionalism of both design and manufacturing.

## DEDICATION

I dedicate this research work to all the staff of the Hatshepsut for Alabaster Factory at Luxor. The new Egyptian generation who are trying to remind the whole world with the alabaster products manufactured by their grandfathers.


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