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## MECHANICAL ENGINEERING IN ANCIENT EGYPT, PART X: POTTERY INDUSTRY (MIDDLE TO NEW KINGDOMS)

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### **Abstract:-**

*This research paper explores the development of mechanical engineering in terms of the development of the pottery industry during the era from the Middle Kingdom to the New Kingdom. The development of the pottery design and decoration is traced with samples of pottery ware are presented and analyzed. The decoration technique of the pottery ware during the period from the Middle to the New Kingdoms is investigated with samples. Different kinds of pottery ware are outlined with description of their main parts.*

**Keywords:** *Mechanical engineering history, ancient Egypt, pottery industry, Middle Kingdom to New Kingdom.*

## I. INTRODUCTION

Pottery industry reflects a large portion of domestic ware used during the daily life in ancient Egypt. Because ancient Egyptians were so generous, they invented too many types of pottery ware suitable for various applications. During the predynastic periods they produced two-color pottery through burning, decorated pottery through painting and innovative product-designs. Part IX of this series of research papers presented the pottery industry up to the Old Kingdom, and here in Part X, the era from the Middle Kingdom to the Late Period is covered.

Williams (1992) studied the pottery in the New Kingdom: its manufacture, classification and its shape [1]. McGovern (1997) studied the wine in Egypt during the New Kingdom, a period of remarkable international's and cultural development as he said. He presented some designs of the pottery amphoras and flasks used to store the Egyptian wine. He analyzed the fabrics of the exterior and interior surfaces of the amphoras as affected by the firing during its production [2]. Spencer (2006) announced that the amount of the Late Period Egyptian Pottery from Noukratis in museum collection is small. He also stated that the Egyptian wares could not match the attractiveness and interest of the fine Greek pottery that covered the site. He analyzed some pottery including dishes, bowls, cups and vessels in some museums including the British Museum [3]. Wodzinska (2007) made a provisional assessment of the potters from the survey at Tell el-Retaba indicating that most of the recorded vessels were from Late New Kingdom and the Third Intermediate Period. Few shreds were associated with the Late Period and probably one from the Ptolemaic Age. She showed that the Late New Kingdom – Third Intermediate pots were either uncoated or had a white/pinkish slip [4].

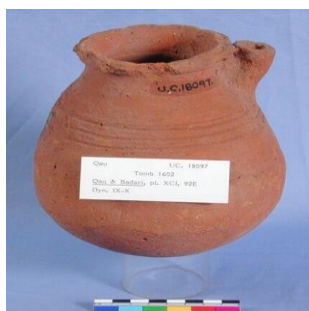
Marcus et. Al. (2008) studied the Egyptian pottery during the Middle Kingdom in Tel Ifshar. They presented and discussed the material in stratigraphic order and classified the pottery fabrics according to the 'Vienna System' [5]. Budka (2009) studied a case study of blue painted pottery at three Upper Egyptian sites essentially an inquiry into contexts and material during the New Kingdom. He studied three case studies of pottery from Elephantine, South Abydos and Umm el-Qaab [6]. Wodzinska (2010) investigated the Egyptian pottery during Naqada III, Old Kingdom, First Intermediate Period and Middle Kingdom. She studied the pottery material, manufacture, surface treatment and types. She presented colored photos for pottery from the time periods she studied [7]. Rzepka et. Al. (2011) studied the houses and some findings in Tel el-Retaba in the north-east of Egypt during the New Kingdom and the Third Intermediate Period. Among the findings were pottery and ceramic ware from the 18<sup>th</sup>, 19<sup>th</sup> dynasties and the Third Intermediate Period [8].

Brietak and Kopetzky (2012) investigated some pottery ware from the Middle Kingdom to New Kingdom in Northern Sinai, Tell el-Daba and Kerma [9]. Panagiotou (2014) in her research for a Ph.D. degree put some questions and tried to answer them in the course of her thesis: How much ?, When ?, Where ? and Why. She explored the characteristics of pottery and the changes in it during the second millennium BC in the eastern Mediterranean including: Egypt, Southern Levant, Northern Levant, Cyprus and Aegean [10]. Hassaan (2016) studied the pottery industry in ancient Egypt during the periods from Badarian of the Predynastic to the Old Kingdom. He presented samples of the available Egyptian pottery around the world allocated to the periods under study. He performed some analysis illustrating some of the characteristics, location (if known), origin (if known), decoration and manufacture [11].

## II. Middle kingdom

The Middle Kingdom covers the 11<sup>th</sup> and 12<sup>th</sup> dynasties during the time span from 2000 to 1700 BC [12]. Some of the pottery samples from the Middle Kingdom and their characteristics are presented below:

- Fig.1 shows a pottery jar from early Middle Kingdom (11<sup>th</sup> dynasty, about 2000 BC) located in Petrie Museum of UK [13]. The jar has an ovoid body, short neck, medium mouth, round rim and slight-flat base. It has only one handle, one color without any type of decoration.
- Fig.2 shows a tall pottery vase from early Middle Kingdom (11<sup>th</sup> dynasty) located in the Petrie Museum [14]. It has an ovoid body, medium neck, shallow mouth, wide round rim, and medium flat base. The outside surface is polished and has one color without any decoration. The neck and base are integrated smoothly with the body.



**Fig.1 Pottery jar from early Middle Kingdom [13].**



**Fig.2 Tall vase from early Middle Kingdom [14].**

- Fig.3 shows a unique model from the early Middle Kingdom (11<sup>th</sup> dynasty) at Sedment (belongs now to Bani-Sweif Governorate) and displayed in Petrie Museum [15]. This is a unique design invented by the Egyptians in Upper Egypt. The pottery stand supports five pottery jars or pots. Because pottery are relatively porous, they leak liquids in it specially water. Therefore, I think that the objective of this pottery stand is to reserve leaked water and collects it in one container. The 6<sup>th</sup> hole in the front is in a level below that of the jars resting on the stand. Thus, most properly it is for discharging the stand or maintaining the water level at an assigned level.
- Another models of pottery jars from the 11<sup>th</sup> dynasty is shown in Fig.4. They are from the tomb of Aashait at Der el-Bahri of Egypt and now displayed in the Metropolitan Museum of Art at NY [16]. The body is ovoid, the neck is short, the rim is round and the base is round. It has no handles and without any decorations. Most probably they storage jars.



**Fig.3 Multi-jars stand [15].**



**Fig.4 Jars from tomb of Aashait (11<sup>th</sup> dynasty) [16].**

- Now, we move to some pottery samples from the 12<sup>th</sup> dynasty. Fig.5 shows a number of pottery jars and bowls from the tomb of Queen Weret II from the pyramid complex of King Senwosret III (the 5<sup>th</sup> King of the 12<sup>th</sup> dynasty of the Middle Kingdom) [17]. There are three jars and two bowls displayed in the Metropolitan Museum of Art. The three jars have different designs. The bowls have same design but of different capacity. All the units have a flat base and no decoration. The polishing degree varies from unit to another.



**Fig.5 Queen Weret II pottery ware [17].**

- A model from the 12<sup>th</sup> dynasty has a unique design and color. It is a white jar shown in Fig.6 and located in Petrie Museum [18]. It has an ovoid body, short small diameter neck, flat-side tall rim and round base. The body is decorated by geometrical shapes which is uncommon in this period. A large collection of pottery ware from the tomb of lady Senebtisi at Lisht during the rein of King Amenemhat III of the 12<sup>th</sup> dynasty is shown in Fig.7 as displayed in the Metropolitan Museum of Fine Art [19]. The jars have different designs and three levels of length. The dishes have one design and one size. All the pottery ware are shown in Fig.7 not decorated.



Fig.6 White jar from 12<sup>th</sup> dynasty [18].



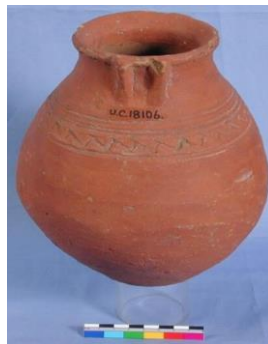
Fig.7 Pottery collection from tomb of lady Sebtisi of the 12<sup>th</sup> dynasty [19].

- **Decorated pottery from the 12<sup>th</sup> dynasty:** Fig.8 shows three different decoration schemes. The scheme in (a) depends on scratching the external surface of the pot (the top half of the body). The scheme in (b) consists of a zigzag line bounded by two straight lines on the external surface of the pot in its top half. The decoration scheme in (c) depends on corrugating the body of the pot over the whole body. The three models have one color and located in Petrie Museum [20], [21], [22]. In the 12<sup>th</sup> dynasty, they decorated some of their pottery plates internally. Fig.9 shows two plates decorated internally by scratching the internal surface (or using a special mold) by scenes for plants and nearly straight lines

(a) Or by parallel curves with free space filled by parallel crossed-straight lines [23], [24]. They are displayed in the Petrie Museum.



(a) Spherical decorated pot [20].



(b) Ovoid decorated pot [21].



(c) Corrugated pot [22].

Fig.8 Decorated pots from the 12<sup>th</sup> dynasty.



(a) With parallel lines [23]



(b) With parallel curves [24].

Fig.9 Decorated plates from the 12<sup>th</sup> dynasty.

### III. SECOND INTERMEDIATE PERIOD

This period of the Egyptian history covers the 13<sup>th</sup> to 17<sup>th</sup> dynasty during the interval from 1802 to 1550 BC [25]. During this period, North Egypt was invaded by Hyksos coming from Palestine and hence, this is expected to reflect on the pottery industry in this region during the period of the 2<sup>nd</sup> Intermediate Period [26]. Here are samples of pottery production during this period:

Fig.10 (a) shows a classical pottery plate without any decoration displayed in the Petrie Museum [27]. It has no decorations, the base has a medium dimension and the body has uniform accurate dimensions. A unique design of a pottery bowl is shown in Fig.10 (b) [28]. The rim is squeezed from 4 sides to form 4 spouts without any decoration.

Another un-decorated bowl design is shown in Fig.10 (c) [29]. It has a conical body, double-conical rim and a medium base. A white ovoid jar is shown in Fig.10 (d) [30]. It has a narrow-short neck, medium mouth, round rim and flat small base.



(a) Pottery plate [27]



(b) Pottery spouted bowl [28]



(c) Long bowl [29]



(d) White ovoid jar [30].

**Fig.10 Plate and bowl from the 2<sup>nd</sup> Intermediate Period.**

- The impact of the Hyksos invasion to Egypt on the pottery industry is illustrated from models found in the Tell el-Yahudyah district and displayed in the Petrie Museum. Fig.11 (a) shows a black pottery jar with an ovoid body, medium neck, round rim, single hand between the rim and body and medium base. A similar model is shown in Fig.11 (b) but with double conical body with decoration through crossed straight lines.



(a) Black jar [31]



(b) Double conical jar [32]

**Fig.11 Jars from Tell el-Yahudyah.**

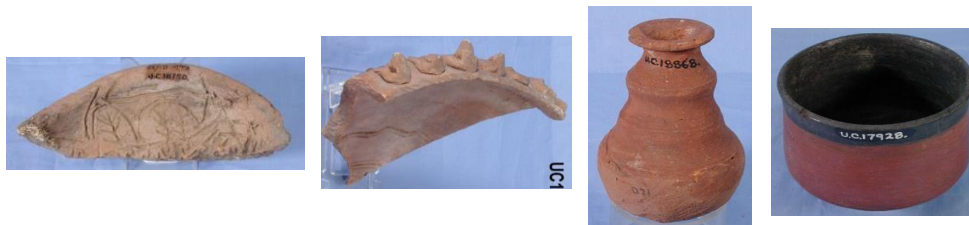
- A unique model from Upper Egypt at Thebes is from tomb B23 of the 17<sup>th</sup> dynasty is shown in Fig.12 and displayed in Petrie Museum [33]. It is a vessel taking of a design simulating a duck with body decoration in the form of duck-feathering and one handle in the top. The vessel mouth is narrow located near the duck-head and the rim is flat. This design a pure ancient Egypt design and not affected by the Hyksos culture who were in Lower Egypt.





**Fig.12 Duck-vessel from the 17<sup>th</sup> dynasty [33].**

- **Pottery decoration in the 2<sup>nd</sup> Intermediate Period:** The pottery decoration experienced in the Middle Kingdom continued to take place during the 2<sup>nd</sup> Intermediate Period. Samples of the decorated pottery ware are shown in Fig.13. In Fig.13 (a), the pottery technician used scratched-plants scene on the internal surface of the plate. In Fig.13 (b) he used external figures (may be for snakes) arranged on the rim of the pottery ware. In Fig.13 (c) he decorated the jar through corrugating its body. In Fig.13 (d) the designer went back to one of the decoration techniques used in the Predynastic period using the firing technique to produce two colors [11]. Other decoration schemes are depicted in the pottery ware shown in Figs.11 (b) and 12.



**(a) Decorated plate fragment [34]. (b) Decorated fragment [35] (c) Corrugated body Jar [36] (d) 2-colors jar [37]**

**Fig.13 Pottery decoration from 2<sup>nd</sup> Intermediate Period.**

#### **IV. New kingdom**

The new kingdom includes the 18<sup>th</sup> to 20<sup>th</sup> dynasties covering a time span from 1570 to 1069 BC [38]. This one of the richest and strongest periods in the Egyptian old history. Therefore, we expect to see a highly developed pottery industry during this kingdom. It is well known that the 18<sup>th</sup> dynasty of ancient Egypt was the richest one over the whole old history of Egypt. Wonderful pottery ware from the 18<sup>th</sup> dynasty reflect this historical fact. Extensive novel decorations of the pottery ware took place during this rich dynasty as illustrated below:

##### **18<sup>th</sup> dynasty:**

- Fig.14 (a) shows a pottery jar from the palace of Pharaoh Amenhotep III, the 9<sup>th</sup> Pharaoh of the 18<sup>th</sup> dynasty [39]. The jar has an ovoid body, medium neck, round rim and round base. It has 2 big handles. It is decorated by an animal head at the neck and painting scenes in 2 colors covering about 60 % of the body, the neck, rim and handles. Another model of the decorated pottery of the 18<sup>th</sup> dynasty is shown in Fig.14 (b) from the rein of Pharaoh Akhenaten, the 10<sup>th</sup> pharaoh of the 18<sup>th</sup> dynasty [39]. The design is similar to that shown in Fig.14 (a) but it has no handles and the surface of red color is highly shining. The decoration bands are narrow and cover about 50 % of the body. Another example of decorated pottery using multi-color painting is shown in Fig.14 (c) from rein of Pharaoh Akhenaten [40]. It has a decorating bands with scenes for lotus and papyrus plants and geometrical shapes. There is a wide decorating band on the body plus one narrower decorating band. The neck is also decorated. The bands are outlined by black straight lines. There is a red straight line on the neck.



**(a) Jar from Amenhotep III palace [39] (b) Jar from rein of Akhenaten [39] (c) Jar from rein of Akhenaten [40]**

**Fig.14 Decorated pottery ware.**

- Now, we move to the rein of the young rich Pharaoh Tutankhamun, the 13<sup>th</sup> Pharaoh of the 18<sup>th</sup> dynasty. The whole world knows the high technological treasures of Pharaoh Tut [41]. Fig.15 shows a water colored jar for Pharaoh Tut [42]. The body is ovoid, the neck is long, the mouth is wide decreasing gradually to the neck diameter, the rim is round and the base is round. It is decorated by 2 colors: red color for 3 areas on the body, neck and rim-neck transition and light blue in 2 bands on the body and neck.



**Fig.15 Colored water jar of Pharaoh Tut [42]**

- Finally, a model from the tomb of Pharaoh Horemheb, the last Pharaoh of the 18<sup>th</sup> dynasty is shown in Fig.16 [43]. It has a complex body design, narrow mouth, short neck, flat base and a vertical sprout. It has external decoration most probably through painting.



**Fig.16 Jar from the tomb of Horemheb [43].**

- Now, we present a fantastic sample of the wonderful pottery vessels of the 18<sup>th</sup> dynasty. It is a long necked decorated vessel found at Abydos, shown in Fig.17 and displayed in the Museum of Fine Arts of Boston [44]. Its body is ovoid, its neck is cylindrical and long, its lip is conical, its base is flat. The body is extensively decorated with multi-colors-scenes within parallel bands in the top half of the body. The rim is decorated by plant scenes and the neck is decorated by 3 parallel lines near its top end.



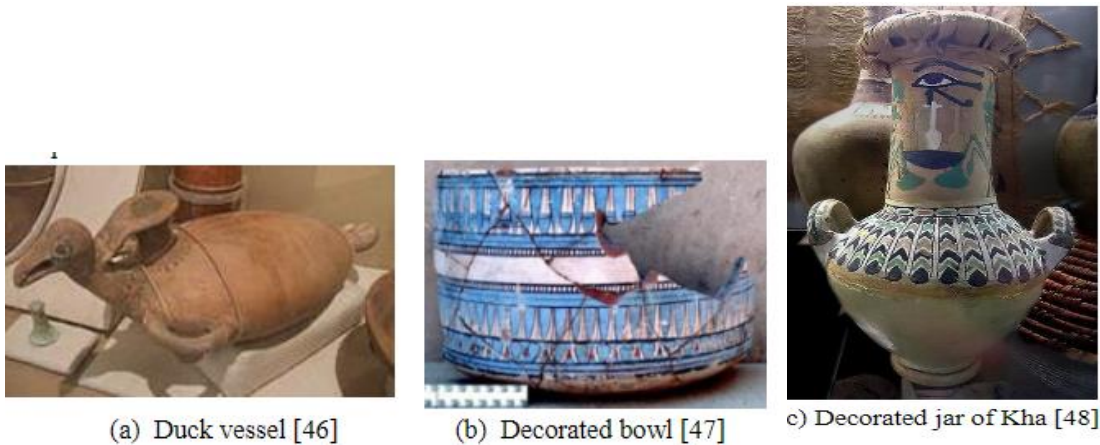
**Fig.17 Long-necked vessel [44].**



**Fig.18 Painted jar from 18<sup>th</sup> dynasty [45].**

Another model of painted pottery from the late 18<sup>th</sup> dynasty is shown in Fig.18 [45]. It has an ovoid body, no neck, small rim, medium mouth and round base. It is painted over about 60 % of its body using plant-scenes set between bands varying in width. The painting is in a light blue color.

- The last three models from the 18<sup>th</sup> dynasty are shown in Fig.19. The model of Fig.19 (a) is for a duck vessel [46]. The mouth of the vessel is near the duck neck, it has an abnormal rim, medium neck, ovoid body, handles at the front end. It is decorated by engravings on the vessel body. The second model shown in Fig.19 (b) is for a decorated bowl from the 18<sup>th</sup> dynasty [47]. The decoration was applied by painting with white and blue colors and takes geometrical shapes. The shapes are extensive and requires high technology to design, draw and apply with very accurate manner. The wonderful and high quality jar of the great Architecture Engineer Kha is shown in Fig.19 (c) [48]. It has a double conical body, long-wide neck, two vertical medium handles, flat edium base. The neck is ecorated by scenes including the Horus eye and the top half of the body is decorated by geometrical shapes within vertical parallel bands with very accurate dimensions. The two handles are also along their



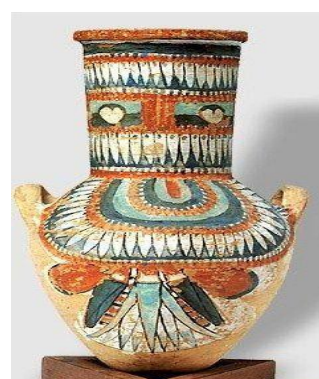
**Fig.19 Duck vessel, decorated bowl and jar from the 18<sup>th</sup> dynasty.**

**19<sup>th</sup> dynasty:**

- A wonderful sample of a colored-pottery jar from the tomb of Sennedjem, the official of excavation and decoration of the royal tombs in the rein of Pharaohs Seti I and Ramses II is shown in Fig.20 [49]. The body is double conical, the neck is conical, the mouth is wide, the rim is round and the base is round. The decoration is performed by painting and covers completely the neck and partially the body. The neck decorations take the form of multi-colors bands and the body decorations take the shape of necklaces originated at the neck bottom boundary. It has 2 small handles at about 45 degrees from the horizontal direction. Another decorated model from the tomb of Sennedjem is shown in Fig.21 [50]. This model is similar to that in Fig.20 except its neck which is cylindrical and its handles which are nearly vertical. The neck cored decoration which has two bands similar to that on the body, new decoration patterns on the middle band on the neck and on the body. The wonderful aspect here is the colored painted decoration of the two models that still keeping their attraction and fixed colors over thousands of years. This illustrates how the chemical engineering knowledge of those people was highly sophisticated and persistent.



**Fig.20 Colored jar of Sennedjem [49].**



**Fig.21 Colored jar of Sennedjem [50]**

A third pottery model from the 19<sup>th</sup> dynasty is shown in Fig.22 (a) [51]. It was designed and produced as a funerary jar. It has a rough surface, conical body no neck, flat wide base and large round rim. It has a lid of output diameter matching the rim outside diameter and an inside diameter matching the jar moth. It is labeled in a colored vertical band with inscriptions of the dead person. A fourth model from the 19<sup>th</sup> dynasty is for double conical jar with lid shown in Fig. 22



(b) [52]. The lid is spherical and has an animal at its top to catch the lid from it. It is decorated on its body by different scenes through painting.



(a) Funerary pottery jar [51].



(b) Double-conical jar with lid [52].

**Fig.22 Funerary jars from 19<sup>th</sup> dynasty.**

- A last pottery model from the 19<sup>th</sup> dynasty is shown in Fig.23 [53]. It has a conical body, no neck, no handles, round lip and flat base. The mouth diameter is slightly greater than the base diameter. It is has one color and decorated by an engraved lady head picture.



**Fig.23 Wide mouth jar from the 19<sup>th</sup> dynasty [53].**

## V. Conclusions

- The development of the pottery industry during the Egyptian Middle to New Kingdoms was investigated.
- Good improvement in pottery design and decoration was achieved during the New Kingdom.
- A unique multi-jars stand was designed in the 11<sup>th</sup> dynasty of the Middle Kingdom.
- Polished royal pottery ware from the 12<sup>th</sup> dynasty were designed and produced having various shapes.
- Un-colored pottery decoration took place in the 12<sup>th</sup> dynasty.
- A unique design for a spouted bowl by squeezing the bowl top edge was applied in the Second Intermediate Period.
- White pottery jars appeared in the 12<sup>th</sup> dynasty and the Second Intermediate Period.
- Black pottery jars appeared in the Second Intermediate Period.
- A duck-shaped design of a pottery vessel was applied in the 17<sup>th</sup> dynasty.
- Internal and external decorations of some pottery ware using the scratching technique appeared in the Second Intermediate Period.
- In the New Kingdom, extensive decoration of pottery ware took place in the rein of Amenhotep III, Akhenaten and Tutankhamun. The designed and produced long-necked vessels in the 18<sup>th</sup> dynasty with wonderful multi-colors paintings which could sustain the environmental effects for thousands of years up to now.
- They designed and produced vessels simulating birds and bowls of extensive multi-colors decoration in the 18<sup>th</sup> dynasty.
- Wonderful painted multi-colors jars appeared in the 19<sup>th</sup> dynasty in the Tomb of the high official Sennedjem with hands of different orientation.
- They used pottery jars with lids for funerary purposes with simple external decoration.

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