

Original Research Article**A Typology of Traditional Ceramic Kilns in Iran from the Prehistoric to the Contemporary Period***

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Abstract

Traditional ceramic kilns in Iran have long been companions of potters but each of which has had different heating methods in each region of the country and a period of construction that is dependent on the region. Iranian potters of different ages, along with the progress in the industry, have changed their ceramic kilns to improve the quality of their wares. Depending on the local conditions, these changes are different in each place. The purpose of this research is to identify and investigate traditional Iranian ceramic kilns. To achieve this purpose, it is necessary to classify these kilns. This research used a descriptive-analytical method to analyze the data from archaeological excavations and field visits. These kilns can be classified in terms of placement in the ground, draft, heating methods, and atmospheric conditions inside the kilns. In terms of the location of the kilns in the ground, they have been classified into three categories: kilns on the ground, half-buried, and underground, which is the primary element of classification in this research.

Keywords: *Kiln, Typology Ceramic Kiln, Traditional kiln, Iran.*

Introduction

The ceramic kiln is one of the primary human tools used to strengthen clay vessels. The first kilns were built 10 thousand years ago. The basic kilns had a very simple form, in the form of a pit in the ground, and their temperature did not exceed 700–800 degrees. More advanced kilns, with the ability to increase the temperature up to 1000 degrees and control the temperature and air circulation in all parts of the kiln, have eliminated all the defects in the output product of the kilns. In the Islamic era, ceramic kilns were removed from the pit in the ground and had a fixed structure,

which led to the production of containers with various types of glazes. In the evolution of kilns, potters have experimented with countless types of kilns, each of which reflects the needs, traditions, skills, and materials of each period and region. In the contemporary period, despite the progress in ceramic kilns, we see that some areas are using older technology kilns. These potters use the kiln technique, which was used in prehistoric times and is still used in the present era. Ceramic kilns are one of the most important tools in the art of ceramics. In each region, ceramic artists make their kilns with unique characteristics. The current research was carried out to identify and investigate traditional

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Iranian ceramic kilns, so the article seeks to answer this question: How can ceramic kilns in Iran be classified according to their technical structure? Considering the lack of resources related to Iranian ceramic kilns and also the lack of a source that introduces Iranian ceramic kilns, this research can provide a complete introduction to Iranian ceramic kilns and also consider the partial or complete destruction of ceramic kilns. However, it is possible to form a definite opinion about the ceramics of the previous era concerning the construction and arrangement inside the kiln. For this reason, by examining the traditional kilns of the present era, which can be considered evolved examples of the same kilns, assumptions, and ambiguities are acknowledged.

Research Background

Most of the research conducted concerning ceramics and explorations in this field are focused on ceramic objects and their motifs, and less attention has been paid to kiln firing and ceramic heating techniques. The recent studies related to ceramic kilns are generally related to archeology and the discovery of ceramic vessels and their firing chambers in different regions of Iran. Noori Shadmahani (2019), in this article on determining the functional structure and chronology of the city of Mishkawieh ceramic kiln, explored the excavated ceramic kiln in the city of Meshkin Tappeh, which belongs to the Islamic era. Saadatfar (2018), in his article on the study of handmade ceramics from Holonchokan village in Qasreqand with an ethnoarchaeological approach, has discussed the relationship between the ceramics of this region in the contemporary era and the prehistoric ceramics. He equates the techniques of making and heating with the prehistoric techniques of this region. Farjami (2015), in a research article on ceramic kiln architecture obtained from the third season of exploration in the historical city of Belgheis village of Esfarayen city, explored one of the ceramic kilns of the historical village of Belgheis belonging to the 12th century. Considering that the ceramic kilns of the Islamic era all have a fire pit and a wares chamber,

and there is a grid between these two plates, the kiln of this region is considered to have no space between the wares chamber and the firing chamber. Nazari (2014), in the book "Pottery in Balochistan," show the art of pottery in Balochistan, especially in the villages of Kalporagan, Kumitak, and Holonchokan, as the most valuable art of the Baloch people and introduce this art as one of the most important parts of the region. Streily (2000), in the article Early Pottery Kilns in the Middle East, studied 89 pottery kilns from 15 sites in Iran, Iraq, and Syria. He also considers the oldest kiln found in the Middle East to belong to the Hasoona culture. Sheikhi and Ashuri (2008), in their article entitled "Determining the Technical and Artistic Characteristics of Ceramics in Mand Village, Gonabad County," described two types of kilns on the ground and underground in this area. Wolff (2010) is one of the researchers who have conducted studies on contemporary kilns in Iran. In his book, he has examined the Beydokht kilns of Khorasan, Gilan, and Shahreza of Isfahan in terms of construction and dimensions, as well as the way of working. Kambakhsh Fard (2013), in the book "Pottery: From the Beginning of the Neolithic to the Contemporary Era," comprehensively examines all aspects of the art of pottery, including archeological explorations and the techniques of making and firing clay objects from the prehistoric era to the contemporary era. Most of the kilns described by Majidzadeh (1975) in his research belong to the pre-Islamic era in Iran. He considers the oldest pottery kiln in Iran from the 7th millennium BC in Jaffarabad, Khuzestan. Kambakhsh Fard (1970), in another book entitled "Neyshabur and Pottery Explorations in the 11th and 12th Centuries," studied pottery kilns and described them.

Most of the resources that are related to ceramics focus more on the product than on ceramic kilns. There are only archaeological excavations that have investigated the construction of kilns and described a kiln, a historical period, or a region. Among the research that has been conducted in this regard, Majidzadeh (1975) has described the excavations

carried out about pre-Islamic ceramic kilns in Iran and described the Islamic era very briefly by mentioning one example. This research has been done due to the lack of a comprehensive source related to ceramic kilns and to categorize the traditional kilns of Iran.

Classification of Ceramic Kilns

Iran's traditional ceramic kilns can be classified according to the draft, heating method, atmospheric conditions inside the kiln, and the amount of placement in the ground. There are three types of kilns according to the amount of placement in the ground in Iran, which include kilns above the surface of the ground, half-buried, and underground; there are one or two samples in each region, although the placement of kilns inside the ground is more common in the areas where more sedimentation takes place because the amount of sedimentation in the alluvial cone causes the kiln to be completely buried (Farjami, 2015, 161). It should also be kept in mind that heating methods rely on fuel. For this reason, potters in each period and region had their methods. In this research, kilns in each period and region have been classified according to:

- a) the extent to which it is placed in the ground
- b) atmospheric conditions inside the kiln
- c) type of draft

• Ground kilns

Among the prototypes of this category of kilns, we can mention the home ovens, in which they heated their clay objects ten thousand years ago. The basic furnaces of this category were very simple kilns that only included: a stone wall and after each firing, their building or roof was destroyed and they did not have a fixed structure. There are few of these kilns because compared to underground or intermediate kilns, they have lower heat retention; Especially in the Islamic era, when the quality of the kilns was important for firing various glazes; For this reason, we rarely see kilns on the ground. One of the current examples of this category, whose building is completed on the ground, is the ceramic kiln of Lalejin city in Hamedan

province, which is still functional and is used (Fig. 1). The ceramic kiln in Lalejin is a fixed brick structure built with ordinary bricks, which has a regular circular shape from the inside and a quadrilateral from the outside. The kiln is made of ordinary bricks that are used in building construction, which are arranged in rows next to each other and connected using mud mortar. The ceramic kilns in this area are large, in the middle of which there is a niche to arrange wares. To prevent heat under the niche, four outlets are placed in the outlets of the kiln floor, which lead to the chimney (Fig. 2).

• Half-buried kilns

Most ceramic kilns are built Half-buried. Lower Parts of the kilns, including the fire chamber and the vessels chamber in the basement, and its upper parts, including the dome, are built above the ground level (Farjami, 2015, 161) (Fig. 3). In most of this category kilns, the firing chamber is destroyed after every firing, and for this reason, most kilns of this kind do not have a fixed vessel chamber structure. Neyshabur (Kambakhsh Fard, 1970), Siraf (Majidzadeh, 1975), Mishkoye (Noori Shadmahani 2019), Takht-e

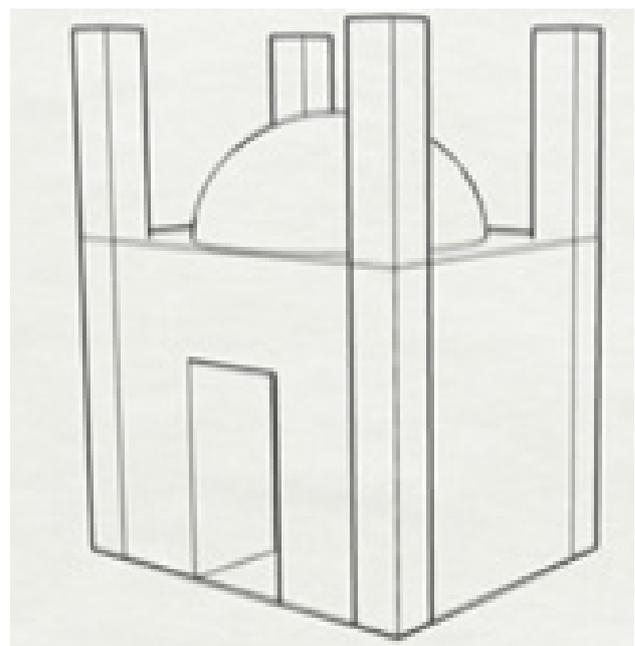


Fig. 1. Lalejin ceramic kiln. Source: Authors.



Fig. 2. Outlets used under the niche in the Laljin ceramic kiln. Source: Authors.

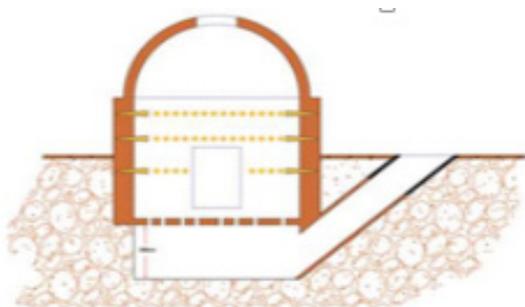


Fig. 3. Reconstructed design of Intermediate ceramic kilns. Source: Nurishadmahani 2016, 269.

Soleyman (Naumann, 1995), Kashan (Sadiyani & Ahmadian, 2013), Esfarayen (Farjami, 2015), Jaffarabad (Majidzadeh, 1975), Yarim Tepe (Streily, 2000), Tepe ghabristan (Majidzadeh, 1975), Chogha Mish (Alizadeh, 1985), Tell Iblis (Majidzadeh, 1975), Sialk (ibid.) and Kahrizak (Talari, 2018) belong to this category (Fig. 4).

• Underground kilns

This group of kilns is completely built underground. The basic kilns had a very simple shape and were just a pit in the ground. It is an evolved example of the earlier kiln. Of course, the placement of the kilns in the ground helps to maintain heat and optimal use of fuel, and it causes the better and faster firing of the vessels in the kiln (Farjami 2015, 161) These kilns are a manifestation of the primary technology of using fire (Abedi, 2003, 25). In some regions of Iran, such as Holonchokan in Sistan Baluchistan province, these primary kilns are still being used. Shahreza and Gonabad are among the areas that have underground

kilns that are still used (Fig. 5).

Kiln draft

There are three types of draft: down draft, cross draft, and updraft for ceramic kilns. There are two types of ceramic kilns in Iran in this category: downdraft and updraft (Fig. 6); each one has its characteristics. The downdraft type is more efficient for better air circulation in the kiln. Examples of updraft kilns in the pre-Islamic era are Jaffarabad kilns (Majidzadeh, 1975), which are a type of half-buried kiln. The ease of making the kiln can be considered one of the advantages of this type of draft. Downdraft kilns usually have better heat retention than updraft kilns. Air circulation inside the kiln, proper draft, and a chimney are the characteristics of a complete kiln. For this purpose, we see kilns with four chimneys on four sides of the kilns and with a downdraft system in the current age in Iran, which creates proper thermal circulation and uniform temperature throughout the kilns.

Atmospheric conditions inside the kiln

If there is a fume inside the kiln, an oxygen-free atmosphere is created, and this condition is called reduction; if there is no fume, it is called an oxidation condition. Both the body and the glaze give different results in any situation. Even though creating oxidation conditions using wood fuel in the kiln was a difficult task, the potters created both oxidation and reduction conditions in their kilns by using wood fuel. Most of the wares produced in the pre-Islamic era are pea-colored, which indicates a fume-free atmosphere in the kiln, except for the black and white vessels of the Iron Age, which were produced by the fume created in the kiln. In his book, Kashani describes how to create oxidation conditions in the kiln as follows: Do not burn firewood until the fume comes out of it completely, so that it does not damage the vessels and does not spoil and blacken. Cut the bark of the willow wood so that it doesn't fume, and then

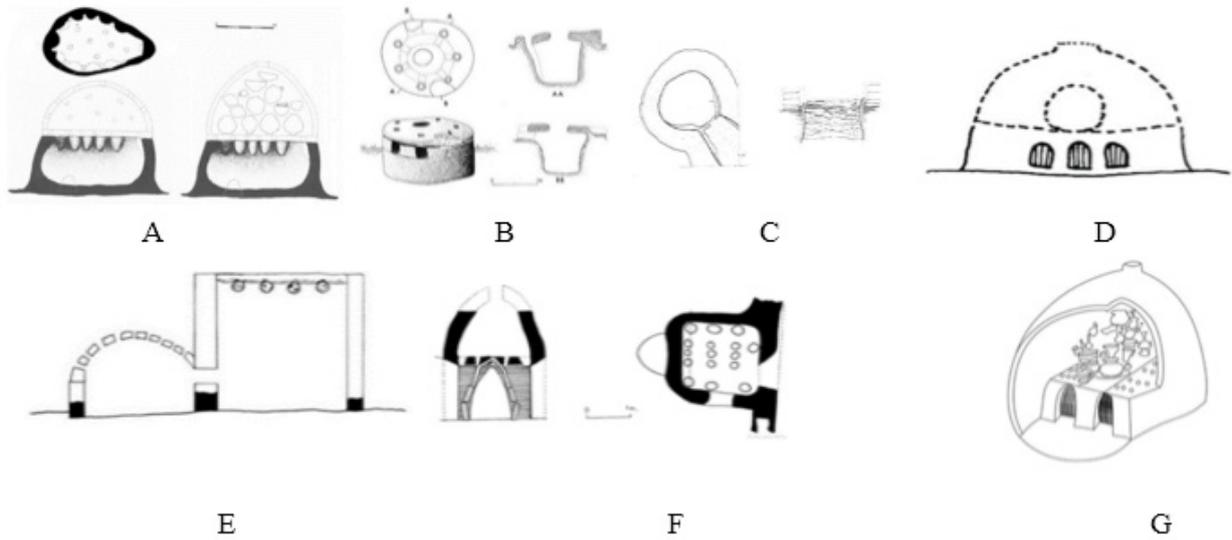


Fig. 4. Various types of kilns: A: Chogha Mish ceramic kiln, B: Yarim Tepe ceramic kiln. C: Jaffarabad ceramic kiln. D: sialk ceramic kiln. E: ceramic kiln from tepe ghabristan. F: ceramic kiln from Tall-i-iblis. G: Kahrizak ceramic kiln. Source: Majidzadeh, 1975.

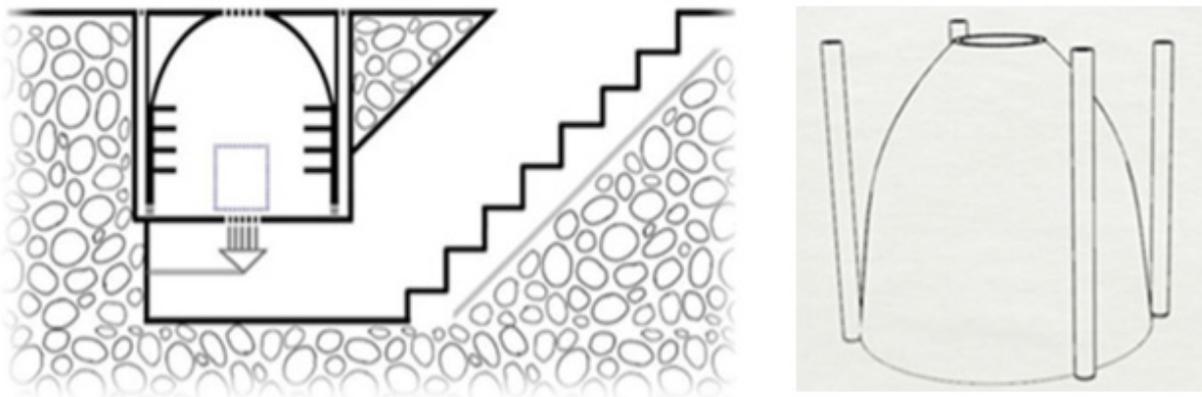


Fig. 5. Ceramic kilns from Shahreza and Gonabad. Source: Authors.

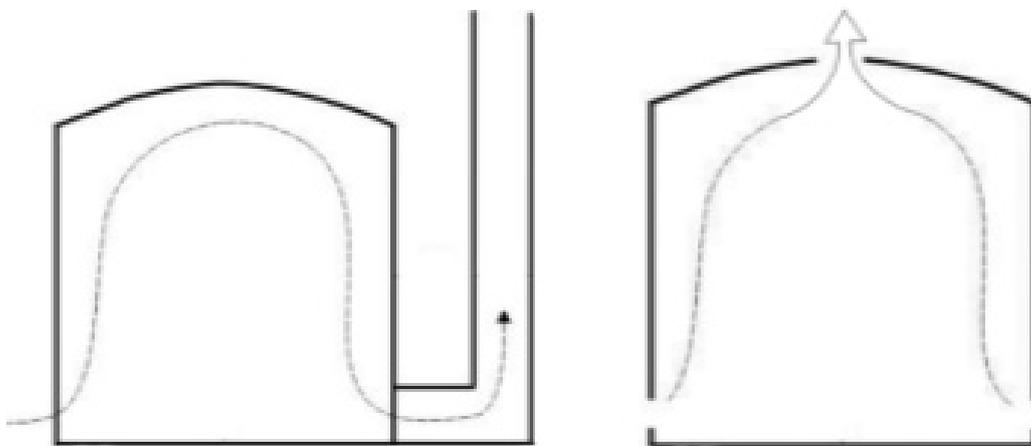


Fig. 6. downdraft and updraft kilns. Source: Authors.

take it out after a week (Kashani, 2007, 364).

Three types of kilns were used in the Islamic period:

- 1)- kiln for heating Zarinfam glaze
- 2)- kiln for heating single-color glazed ceramic
- 3)- kiln for heating multi-colored parts (Sadiyani & Ahmadian, 2013, 4).

Fuel and Heating Method

The fuel that was used for the kiln in the pre-Islamic era and the Islamic era was the same. Fire control and proper fuel supply have been obtained from straw, wood, and dung (Kambakhsh Fard, 2013, 88). In the economic cycle of prehistoric societies, the feeding of straw and fodder by herbivorous animals such as cows and goats was turned into the excrement of these animals, which eventually turned into dung. In this way, other fuel materials were provided in addition to straw, which is better than the straw in terms of fuel quality, heat stability, and slow burning. After drying, the excreta of herbivorous animals provide very suitable fuel (Talai, 2014, 20). The fuel for ceramic kilns was not only animal manure, and the potters of Tepe Dasht also used wood along with animal manure for kiln fuel; Therefore, the combined use of animal manure and wood as kiln fuel is confirmed (Moradgholi, Mortazavi & Shafiee, 2018, 100). The fuel materials of the contemporary period have become completely different, materials such as gas and oil are among the fuels that supply traditional ceramic kilns today, which, in addition to availability in the whole country and low price, should be used in an atmosphere that is cleaner than fume compared to fuels such as wood. Some factors in ceramic kilns such as fuel cannot be identified by archaeologists. Accordingly, when dealing with ancient kilns, it is important to consider modern kilns (Majidzadeh, 1975, 208). We can almost say that all traditional kiln today is equipped with gas or oil burners; which has made the heat control very convenient for the potters and has solved all the defects of the previous rotary kilns to provide a perfect output product.

Kiln temperature was measured in the past in such a

way that skilled and experienced potters controlled the temperature sensibly by observing and touching the kiln (Towhidi, 2013, 31). Also, in the conditions of open firing, the temperature rate and the color of the wares are not the same, in other words, the lack of temperature control in this method makes the true color of the ceramic not appear. The color of ceramic depends on the degree of oxidation of iron and carbon (Abedi, 2003, 23). Today's kilns are mostly equipped with a temperature display inside the kiln, and some of the traditional kilns use the same methods as in the past, that is, visually and taking a sample from inside the kiln.

Kiln structure

The construction of the primary kiln was very simple. The primary kiln has a short cylindrical wall that has openings in the wall to ignite the fire. The upper part of the kiln is made in the form of a dome, which is made anew at each heating time, and a hole or holes are created in the dome part for the draft of the kiln (Rhodes, 2003). The dome cover in this type of kiln is temporary, and it is rebuilt every time it is used. Unless the kiln is very large, in which case they only destroy part of the dome cover (Towhidi, 2013, 34), The lower part of the kiln is usually dug into the ground, and their roof could withstand heating, destruction, and reconstruction for a while, so they were named temporary on this occasion (Kambakhsh Fard, 2013, 92). The ceramic kilns of the Islamic era are slightly different and more evolved than those of previous eras. At the same time as the spread of Islam in the early 7th century AD, the pottery industry, like other arts, gradually began a new era in Iran (Kiani, 1978, 14). The kilns of this period almost all have the same structure. The kilns excavated in Neyshabur were not all the same size, but they shared some details. It has a circular fire chamber with an oval entrance. In the firing chamber, there are "conical clay pegs on which the wares are placed. The end part of the nails, which is smaller, was placed inside the holes in the heating chamber. In small kilns, there is one row of ring holes around the heating chamber, and in larger kilns, there

are three rows (Wilkinson, 1974, 4). The kilns of the contemporary period are to some extent the same as the kilns of their previous eras, with a slight difference in the materials and surfaces used in the kiln. Also, these kilns are made in large dimensions, so to arrange them inside the kiln, the potter must go inside the kiln and fill the kiln with the help of the apprentice (Fig. 7). Among the advantages of this kiln, we can mention the dome roof and four chimneys on the four sides of the kiln, which cause better circulation and uniformity of air in the kiln.

Kiln loading

Loading the kiln has always been one of the great challenges for potters because glazed wares should not be in contact with anything. The potters of the early Islamic era thought of a place to place these vessels to prevent glazed vessels from coming into contact with one another. As mentioned earlier, the ceramic kilns of the Islamic era had clay balls that fit inside the kiln body and were the location of the glazed wares. This matter, in the kilns of the Islamic era, is in an aura of ambiguity because researchers have presented different opinions in this field. But by examining today's kilns, which are very similar to the kilns of that era, this ambiguity can be



Fig. 7. The Shahreza ceramist, arranging clay pots in the kiln. Source: Authors.

put to an end. Also, the way the clays were placed in the kiln was that the small wares were placed away from the heat, and the slightly larger wares were protected on the next floor and behind the larger wares. When blocking the kiln, prepared clay molds were used (Kambakhsh Fard, 2013, 311). The way of arranging wares in the kiln is such a way that the containers are placed on the many ledges created inside the kiln, or they are placed hanging on the clay rods that are made in the inner wall of the kiln (Rafii, 2008, 75). Today's potters place them in niches to heat better wares (Wolf, 2010, 144), which consists of clay plates that are placed on ceramic tubes that are placed inside the body of the kiln (Fig. 8) (Tables 1 to 3).

Conclusion

Iran's traditional ceramic kilns can be classified in terms of placement on the ground, draft, and atmospheric conditions inside the kiln. Iran's traditional kilns can be classified into three categories:



Fig. 8. Traditional kiln. The ceramic tubes that are placed inside the kiln body to hold the ceramic plates. Source: Authors.

Table 1. Descriptive table of kilns obtained from archaeological excavations from the pre-Islamic era to traditional kilns of the contemporary era in Iran. Source: Authors.

Number	Kiln	Placement	Draft	Period	Oxidation or reduction	Firing	Source
1	Harsin	On the Ground	-	Neolithic period	reduction		Kambakhshfard (2013)
2	Jaffarabad	Intermediate	Updraft	7th millennium BC	Oxidation	The heat created by wood, dung, thornbush, etc	Majidzadeh (1975)
3	Yarim Tepe		Downdraft	4th millennium BC			Streily (2000)
4	Tepe ghabristan	On the Ground	-				Majidzadeh (1975)
5	Tepe Sialk		Updraft	5th millennium BC			Majidzadeh (1975)
6	Chogha Mish		-	2nd millennium BC			Alizadeh
7	Tall-i-iblis		-				Majidzadeh (1975)
8	Kahrizak			Iron age	Reduction		Talawi (2014)
9	Neyshabur	Intermediate					Wilkinson (1974)
10	Esfarayan		Seljuk dynasty				Farjami (2015)
11	Kashan				Oxidation & reduction		Sadiyani & Ahmadian
12	Takht-e Soleyman		Updraft	Ilkhanate			Kiani & karimi (2013)
13	meshkuye			Seljuk dynasty			Noori Shadmahani (2019)
14	Siraf			4th century Hijri			Majidzadeh (1975)
15	Lalehjin	On the Ground			Oxidation	Gas burner	writer
16	mend		Downdraft				
17	Holonchokan	Underground	-	contemporary	Reduction	The heat created by wood, dung, thornbush, etc	
18	Shahreza		Downdraft		Oxidation	Gas burner	

Table 2. The dimensions of contemporary traditional kilns in Iran. Source: Authors.

Number	City	Kiln dimensions	The number of burners	Fume outlet	Chimney cross-section	Chimney height
1	Lalehjin	3 meters high and 2.5 meters in diameter	1	10 x 10 cm	10 x 10 cm	One meter from the ceiling of the kiln
2	Shahreza	2 meters high and 160 cm in diameter	1	5 cm Diameter	5 cm Diameter	Chimney head at ground level
3	Mend	2.5 meters high and 180 cm in diameter	1	5 cm Diameter	5 cm Diameter	Chimney head at ground level

Table 3. Materials used in contemporary traditional kilns in Iran. Source: Authors.

Number	City	Ceiling	Body (outside)	Body (inside)	Kiln door	Burner
1	Lalehjin	Clay and brick	Ordinary brick	Ordinary brick	Fiber Ceramic and metal	Cast iron
2	Shahreza	Clay and brick	Underground kilns	Ordinary brick	Clay cover	Cast iron
3	Mend	Clay and brick	Underground kilns	Ordinary brick	Clay cover	Cast iron

kilns on the surface of the ground, middle, and underground in terms of the amount of placement in the ground. A developed example of above-ground kilns that is still in use today is the Lalejin kiln. Because the building of these kilns is made of clay and brick and they still use the methods of controlling the heat of their previous era, both the body and the glaze are heated in these kilns, and the final product is delivered without defects. Kilns whose buildings are located on the ground are less common than the other two types because potters built their kilns in the ground to be insulated. Two types: updraft and downdraft, can be seen in traditional Iranian ceramic kilns; in each period, we see these two types of draft. Downdraft kilns have better performance than updraft kilns in terms of better circulation and heat retention in the kilns. Two modes of oxidation and reduction have been used in the traditional kilns in Iran. In each case, we see different results on the glaze and the body. The creation of smoke in the kiln, or the reduction mode in the early kilns, was inevitable, and for this reason, the heating pots of that era took on a dark color. that over time, potters have succeeded in oxidizing conditions in the kiln; but it should be noted that the condition of reduction in the kiln or the creation of smoke is not one of the disadvantages of the work, and for this reason, the potters of the early Islamic era used this advantage to create different color spectrums on their glazes and still Currently, this technique is also used.

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