

## East Roman Imperial Period Glass Production in Antioch of Pisidia: A Preliminary Report

### *Pisidia Antiokheia'da Doğu Roma İmparatorluk Dönemi Cam Üretimi Ön Raporu*


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**Abstract:** Glass finds constitute one of the largest groups among the small finds, with 16.481 piece of glass of different forms and techniques for all kinds of uses, and 780 pieces from glass production, which were unearthed during the excavations in the ancient city of Pisidian Antioch. In addition to these finds, the presence of a glass furnace showing the existence of glass production in the Eastern Roman Imperial Period layers of the city and three further areas with evidence of glass production were identified. Other than glass works, it was documented from the finds unearthed in the city in previous studies that there was the local production of ceramic, stone-working, marble-working, the production of oil lamps and metal-working also existed. In this study, the data on glass production mentioned above were brought together and it was shown with archaeological data that glass production was undertaken in Antioch in the Eastern Roman Imperial Period. Although to date, no production area from the Hellenistic or Roman Republican Periods has been identified in the city, the fact that amorphous and production waste belonging to these periods was found, and the artifacts and kilns that are the subject of this article show glass production also existed in earlier periods. With its large territorium, the city became the centre of pilgrimage for Pisidia and surrounding regions, first with the Temple and Sanctuary of the Moon God Men and later for Christianity. The data supporting a local tradition of production dating from not only to the Eastern Roman Imperial Period but also to earlier periods has been shown.

**Keywords:** Antioch of Pisidia • Eastern Roman Imperial Period • Furnace • Glass Production

**Öz:** Pisidia Antiokheia Antik Kenti'nde yapılan kazı çalışmaları ile açığa çıkartılmış olan, farklı form ve tekniklerde, her türlü kullanıma yönelik 16.481 tane cam parçası ve cam üretimine yönelik 780 parça ile küçük buluntular içerisinde en yoğun gruplardan birisini cam buluntular oluşturmaktadır. Bu buluntuların yanı sıra kentin Doğu Roma İmparatorluk Dönemi katmanlarında cam üretiminin yapıldığını gösteren bir cam fırını ve cam üretiminin yapılmış olduğunu belgeleyen diğer üç alanın varlığı tespit edilmiştir. Cam eserler dışında; kentte açığa çıkarılan buluntulardan seramik, taş, mermer, kandil ve metal gibi materyallerden de yerel üretimin yapılmış olduğu daha önceki çalışmalarda belgelenmişti. Bu çalışmayla yukarıda belirtilen cam üretimine yönelik veriler bir araya getirilerek Antiokheia'da Doğu Roma İmparatorluk Dönemi'nde cam üretiminin yapılmış olduğu arkeolojik verilerle ortaya konmuştur. Şimdilik, kentte Helenistik Dönem ve Roma Dönemi'ne ait cam üretiminin yapılmış olduğunu gösteren bir alan tespit edilememesine karşın özellikle bu dönemlere ait amorf ve hatalı formların ele geçmesi ve de makaleye konu olan eserler ile fırınlar, erken dönemlerde de üretimin yapıldığına ışık tutmaktadır. Ayrıca geniş bir *territorium*'a sahip olan kentin, Ay Tanrısı Men'in tapınağı ve kutsal alanıyla Pisidia'nın ve komşu bölgelerin hac merkezi, sonrasında da Hristiyanlığın hac merkezlerinden birisine dönüşmüş olması, kentte sadece Doğu Roma İmparatorluk Dönemi'nde değil, daha önceki yıllara dayanan yerel bir üretim geleneğini destekleyen veriler ortaya konmuştur.

**Anahtar Kelimeler:** Pisidia Antiokheia • Doğu Roma • Fırın • Cam Üretimi

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Excavations in the ancient city of Antioch of Pisidia, which was organised as a military city in the Hellenistic and Roman Imperial Periods has exposed very rich groups of finds. Glass artifacts, constitutes one of the largest groups among the small finds unearthed<sup>1</sup>. These finds consist of 16.481 glass piece that were produced in different forms and techniques, such as oil lamps and window glass, glass goblets, bottles, plates, bowls and unguentarium for daily use, bracelets, beads and rings for jewellery, and as other glass objects such as appliques, weights and wall coverings. In addition to this processed work, there are 780 pieces of items derived for glass production<sup>2</sup>, consisting of frits, glass slags, the remains of glass production waste, raw glass, amorphous glass, and furnace/crucible residue. Starting from the raw materials and glass production residues, by bringing together the data obtained from these pieces, it will be determined whether glass production occurred at Pisidian Antioch.

The frits uncovered in Antioch<sup>3</sup>, although not very numerous, are in the form of multidirectional fractures and small pieces. Colours are between the range of black and greenish black (Fig. 1). This material was probably imported to save on fuel used in quantity in glass production.

Glass slags<sup>4</sup> are the most concentrated group among the finds belonging to glass production in the city. The colour types are not clearly visible due to the intense colour deformation observed on the slag pieces, which are ofin all sizes. Therefore, at least at present, it cannot be understood whether these show parallels with the glass works produced (Fig. 2).

One of the most important data proving the existence of glass production are the remains of glass production waste<sup>5</sup>. The remains of glass production wastes found in the city are in the form of dense

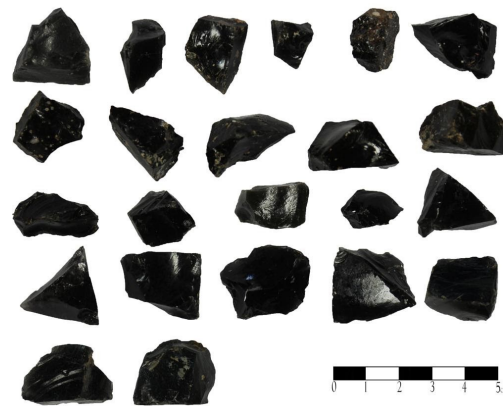


Fig. 1. Frits

<sup>1</sup> The subjects of this study are, the artifacts unearthed during the rescue excavations carried out by the Yalvaç Museum Directorate in 1980 and 2005, and during the excavations between 2008 - 2020 under the direction of Prof. Dr. Mehmet ÖZHANLI.

<sup>2</sup> Areas where finds for glass production were unearthed are: Cardo Maximus, Cardo Maximus West Portico, Cardo Maximus East Portico, Cardo Maximus North, Church of Aedilicus Hill, Aedilicus Postaments, Tiberia Platea, ST. Paul Church, North Church, Theatre, House with Atrium, Bouleterion, The Bath/Headquarter Building (?) and Western Gate Shops.

<sup>3</sup> Frit, is the raw glass obtained in the first stage of glass production by mixing in a certain ratio the silicon, sodium and metal oxides added to the mixture to give colour, and firing at high temperatures in a tank type furnaces. The workshops that buy the frits, add these broken pieces to the other raw materials that make up the glass and put them in the melting pot. In this way, fuel savings can be achieved as this accelerates the melting of the material. Coşkun 2017, 43-44, For tank type glass furnaces, see Freestone & Gorin Rosen 1999, 105-116.

<sup>4</sup> Slag are the pieces formed after melted glass inside the crucible sticks to the bottom of the pot and becomes a layer in time. It is known that the residue in the glass furnace also eventually turns into glass slag Coşkun 2017, 45.

<sup>5</sup> The raw materials that make the glass and the metal oxides added to the mixture for colouring, reach the melting point at 1500 – 1700 C. While these raw materials reach the melting point, as a result of the different reactions they show, lime and water vapor sometimes cannot escape and small blisters, the remains of glass waste form on

porous fragments of various sizes with plenty of the remains of glass wasters. The colours of these fragments are quite similar, they are of a light grey and light brown (Fig. 3). The remains of glass wastes are important in terms of showing that not only glass was produced in Antioch, but also that the raw materials that were employed in making the glass were melted in the city.



Fig. 2. Glass Slags



Fig. 3. The Remains of Glass Wastes

Of the important evidence showing the existence of glass production in the city, there are the finds of glass production waste/production residues. These are small pieces of glass which become waste in the cutting off of the excess, are produced during the shaping of the glass paste. From the cut marks seen on most of these rather amorphous pieces, it is understood that these were cut off and discarded when shaping parts like rims and handles, while the vessels were still hot. Tear shaped pieces that form when the fluid glass drips, and, small pieces of glass that become waste when the shaped form is cut from the glass blowing tube are found. The glass colours of these pieces are very similar to the glass artifacts that were found on the city. These pieces, which are described as production residues, clearly show glass was produced in Antioch (Fig. 4).



Fig. 4. Production Waste

Although they are not very numerous, unprocessed *raw glass* chunks are also found among the glass production finds<sup>6</sup>. These are glass pieces of various sizes. The appearance of fracture marks on the surfaces of some these pieces indicate they may have been cut from a large mass of glass or from unprocessed glass.



Fig. 5. Raw Glass Chunks

Among these pieces, usually greyish green, light green, yellow-light green and dark green colours are

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the surface. Affination process is applied to remove these blisters. In other words, when the glass melts, it is kept at high temperature while the fluid glass inside the crucible is stirred continuously so that the remains of glass waste rise to the surface. The foam formed on the surface is then taken with a spoon-like tool and thrown out of the pot. Discarded, fluid glass bubbles with dense air, the remains of this glass waste, become a grey-dark brown colour as they cool, Baykan & Baykan 2012, 4-5.

<sup>6</sup> For similar examples see: Gorin Rosen 2012, 49-52; Ouahnouna 2021, 267-269.

the most common. It is noteworthy that these pieces are very similar in colour and texture to flat window glass (Fig. 5).

Another group of finds, showing the existence of glass production in Antioch are the *amorphous* glass pieces that could not be correctly formed due to the rapid cooling of the glass during production or which were left unfinished by an unskilled hand<sup>7</sup>. Although there are amorphous parts belonging to almost all forms, the largest groups are bracelets, the base parts of goblets, flat and round window glass and bottles (Figs. 6-7).

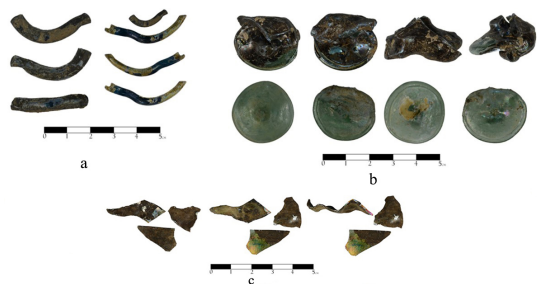


Fig. 6. Faulty Parts



Fig. 7. Amorphous Pieces

The examples of amorphous bracelets are left as trapezoidal rods, which were formed first and reheated later to join at both ends, could not be rounded, due to the delay of the craftsman or trainee in undertaking the joining process combined with the rapid cooling of the glass. In addition, traces of a pliers-like tool can be seen on the ends of some of the amorphous bracelets, which are used to pull from both sides and held, to join the ends (Fig. 6a).

In the examples of amorphous goblets, it was observed from the finds that errors were mostly in the base parts. While the bases were being folded, they could not be completely shaped due to the rapid cooling of the glass, so the bases to stand on a flat surface, had remained uneven. Unlike the others, in one example, while the goblet form is pulled from the base and combined with the body, it is seen that the body of the goblet flowed to the rim of the base due to the excess liquid that remained in the glass paste (Fig. 6b).

Some of the amorphous examples of flat window glass made by the casting technique<sup>8</sup> could not be performed properly or completed and remained in a trapezoidal shape due to an uncontrolled cooling process or from the rapid cooling of the glass paste (Fig. 6c).

On the example of the round window glass<sup>9</sup>; after the glass dough is taken to the shaping rod, its construction was left unfinished due to the rapid cooling of the glass during its shaping. The imprint of the master's finger can be seen as well indicating the reason why the work was not completed. The window glass was left folded and incomplete (Fig. 7a).

In the amorphous bottle examples made through the free blowing technique; It is understood

<sup>7</sup> Weinberg 1962, 133 Plate 28, Fig. 17.

<sup>8</sup> Production of flat window glass through the casting technique; is carried out by pouring the glass paste into moulds which have standard sizes close to a square, or, it is poured onto a flat surface. It is very important after this process that the cooling is undertaken in a controlled manner, and it should be cooled slowly by placing it in the annealing furnace. Baykan & Baykan 2012, 38-39.

<sup>9</sup> In the production phase of round window glass, first the glass is freely blown. After being inflated, it is taken to the shaping bar and turned into a disc, and, lastly the shaping of the edges is done, Baykan & Baykan 2012, 39-41.

from the thickness of the walls of a bottom piece that the blowing process was incomplete due to the rapid cooling of the paste while being blown onto the pipe. It is left skewed by pressing on it. From another example, the shaping of the rim could not be completed from the rapid cooling of the glass paste, and it was left skewed by pressing on top of it. From another example, while removing the bottle from the blowpipe to shape the rim, the neck was bent, resulting in the cutting or breaking process not being performed properly from the glass paste still being hot (Fig. 7b).

The amorphous pieces seen amongst the glass finds of the city provide; are the clear proof of the production of glass works for all kinds of use in the city. Other important evidence of glass production in the city are the furnace residues and fragments from glass melting pots. Among the finds belonging to glass production, some pieces were also found belonging to the glass furnace, glass crucible and the glass processing floor.

A piece thought to have belonged to the glass furnace is the surface of a large plaster lump made from a mixture of stone, straw and tile particles, and which is covered by a dense glass *bubble* of a light grey colour. We know that during the production of the glass paste, the remains of glass waste formed on the surface of the glass melting pot were taken from it with a ladle-like tool and this residue was thrown out<sup>10</sup>. This piece should come from the floor probably from near the position of the glass melting pot (Fig. 8).



Fig. 8. Parts from a Furnace



Fig. 9. Parts from Melting Crucible

It is thought that other pieces of various sizes belong to the glass melting pot. All the pieces are terracotta with glass stuck to their surfaces. When these parts are examined; cracks in the surfaces of ceramics, the hardening of the structure of the ceramics and the appearance of burn marks due to exposure to excessive heat can be seen. These provide strong evidence they came from the glass melting pots (Fig. 9).

Pieces thought to be glass processing grounds are the window-like glass stuck to terracotta which may belong to a flat floor. The glass master usually needs a flat surface during the shaping phase of the forms. For example, in the manufacture of flat window glass, the glass melt is poured onto a flat surface and shaped by applying pressure from the top. For this and similar productions, there must have been flat blocks used to provide a workbench surface near the furnace. Therefore, these pieces probably belonged to the work-bench surface that was employed to shape the glass on (Fig. 10).

<sup>10</sup> Coşkun 2017, 45.

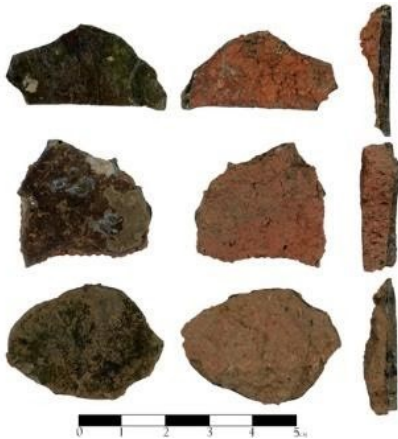


Fig. 10. Parts of Glass Processing Floor



Fig. 11. Glass Furnace in the Bath (?)

The archaeological finds summarized above provide enough data to be able to say glass production existed in Antioch. Apart from this evidence, the furnace unearthed in the city show glass production certainly existed. In the Eastern Roman Imperial Period layers of the city, a furnace and three areas which shows evidence of glass production were located through excavations.

The first of these areas is the Bath (?) structure. Located in the northwest corner of the city, the structure was built in the I<sup>st</sup> century A.D., and was used for a variety of functions until the XI<sup>th</sup> century A.D. It was determined that the upper floor of this two-storey building was demolished after losing its functions in a later period (IX<sup>th</sup> - X<sup>th</sup> century A.D.), and numerous ateliers<sup>11</sup> for different purposes were built in this area above the first floor. The circular formed glass furnace built with brickwork on a stone foundation is the most clearly identifiable of these ateliers (Fig. 11). There is a dense glass melt that has stuck to the preserved brickwork. Only the lid or the opening of the furnace which was preserved on the foundation level was conserved. Although the furnace was preserved on foundation level, based on other furnace examples<sup>12</sup>, it is thought that from the form of the furnace and the remains of the brickwork, it had a dome-shaped upper structure. The thick layers of glass seen on the walls and the floor of the building provide evidence that the furnace was used extensively over a long period of time. Intense production residue and amorphous material unearthed around the furnace indicate that a place of glass production was there.

The second area where glass production is thought to have taken place is in the Eastern Roman Imperial Period Quarter built on the square in front of the Nymphaeum, bordering the *Cardo Maximus* in the north of the city (Fig. 12). In the excavations carried out in the area, alongside the evidence for glass production, fragments of amorphous bracelets were also unearthed. While the square was one of the most heavily used areas of the city in the Early Imperial Period, it lost its function and was reorganized with houses and shops made from *spolia* material of careless workmanship in the later

<sup>11</sup> 16 m to the southeast of the glass furnace, a building that was constructed in the late period and which is understood to have been a large lime kiln was unearthed.

<sup>12</sup> In the ancient city of Tralleis, a similar shaped glass furnace was unearthed in the place built adjacent to the wall, north of the Gymnasium. For details, Yaylılı 2008, 24-27. Another kiln unearthed of a similar form is in the ancient city of Tarsus. For details, Adak Adıbelli 2006, 25-26; 2013, 93-100; Çakmaklı 2014, 132-142; Akkuş Koçak 2018, 245-254; Taştēmür 2021, 31-41.

periods (XI<sup>th</sup> century A.D.)<sup>13</sup>. All the buildings in the square, which has been cultivated as a field for many years, were preserved at a basic level and the walls of many of these buildings were dismantled. Therefore, it was difficult to determine the functions of the individual unearthened spaces. Although no glass furnace was discovered, it is possible that glass production was carried out on the east corner of the square, where the existence of a thick layer of ash, burnt brick pieces and in particular raw glass pieces were found.



Fig. 12. The Square of Nymphaeum/ The Area Considered to be a Place of Glass Production



Fig. 13. Cardo Maximus, West Portico Shops, the Area Considered to be a Place of Glass Production

The third area where the most concentrated evidence for glass production in the city was found and which evidence it is thought to be the place of glass manufacture; are the workshops (Fig. 13) behind the portico west of the street where the Cardo Maximus square finishes and narrows towards south. It is understood from the archaeological findings<sup>14</sup> and architectural changes, the shops with entrances via the West Portico and the house with Atrium, which was built on a large parcel of land date from the Roman Imperial Period and have remained in use until the Late Eastern Roman Imperial Period, changing overtime according to the economy and requirements. The hearth, terracotta kiln and materials unearthened in one of the shops here proves that this was a blacksmith's workshop. Apart from the iron works which were found inside and around the blacksmith workshop, the large number of pieces for glass production, increases the probability that glass was produced in the blacksmith's shop or in one of the adjacent spaces. Considering that the greatest number of finds indicating glass production in the city comes from this area and that these shops were used for both production and sale purposes for materials such as glass, metal and ceramics, it is certain that there was a shop or production house related to glass production and working in this area of the city<sup>15</sup>.

The fourth area where glass production can be understood to have taken place in the city are the workshops to the south of the church on the Aedilicus Hill (Fig. 14). In the excavations carried out, pieces for glass production were unearthened in quantity especially in the church and the structures around it. Although no furnace or crucible remains have been found during the course of these studies, the density in finds of frits, amorphous, *bubble* and slag used in lower temperature manufacturing has shown the existence of glass production. In addition, the studies carried out in the church showed the church was abandoned as a result of a fire after its destruction, and it was understood that the

<sup>13</sup> Özhanlı 2009, 71.

<sup>14</sup> Most of the archaeological finds date from the VI<sup>th</sup> century A.D. and later.

<sup>15</sup> Özhanlı 2014, 14.

building was used for a different function after the Late Eastern Roman Imperial Period<sup>16</sup>. The density of the finds suggests the existence of a glass production house, as well as the fact that glass products may have been manufactured by traveling craftsman around the church in the late period. The reason why a glass furnace was not found, and that the production house cannot be determined precisely is, the possibility that it was destroyed in the later restructuring undertaken. For now, the evidence supports the statement that glass production was undertaken in structures around this church<sup>17</sup>.

As mentioned above, the existence of another furnace, in addition to the glass furnace on the baths is not known for the time being, but the finds regarding the production, support our view that manufacturing was also carried out in other parts of the city. There is no need for large structures in which to produce glass. For this reason, it should be kept in mind that temporary furnaces may have been installed and produced in the areas of the city at the places where it was needed by traveling craftsman coming from outside.



Fig. 14. The Church on the Aedilicus Hill

In addition, apart from glass works; it has been documented from unearthened materials such as: ceramics, stone, marble, oil lamps and metals that local production existed<sup>18</sup>. The existence of a strong local production from different materials supports the presence of glass works production, which requires a very simple space for its manufacturing. The city has a wide hinterland, and it is located on trade routes. It is understood from works of different dates, that all kinds of artifacts were produced in accord with the fashion of the particular period and the city had a deep rooted and strong tradition craft-workshop tradition from the past. Only 10% of the city, which extends over an area of about 67 hectares, has been excavated. Most of the excavated areas belong to the Eastern Roman Imperial Period and Roman Imperial Periods. Therefore, very few examples dating from the early periods, especially the Hellenistic Period, when the city was founded, have been unearthened. For now, there is no evidence of glass production in the city dating from the Hellenistic period<sup>19</sup>.

During the excavations of areas belonging to the Roman Imperial Period of the city, many finds related to glass working were unearthened. Among these finds, slag, residual and amorphous are abundant, which indicates that there was local production. However, since the places where the finds were unearthened were altered, changed during the Eastern Roman Imperial Period, the production house

<sup>16</sup> Özhanlı 2017, 97; Antioch of Pisidia 2016 Excavation Archive.

<sup>17</sup> The ongoing excavations in this area will reveal more information on this issue over the coming years.

<sup>18</sup> Güngör 2019, 25-28; Özhanlı 2021, 427-435.

<sup>19</sup> But just 5 km away from the city, the temple of the Phrygian god Men Askaenos which can be found on a hill at an altitude of 1600 m, and the sacred road from the city to the temple, show the existence of the city in Hellenistic Period and earlier. Since the glass finds unearthened by the excavations carried out there form the subject of another study, the data concerning glass production and glass finds from this period will be explained in future studies.



(s) and the furnace (s) belonging to this period could not be determined. In all these areas, where archaeological data documenting the production of the glass works in the Roman Imperial Period was unearthed, were employed as shops and workshops during the Eastern Roman Imperial Period. The fact that these places were used as shops and workshops in the Eastern Roman Imperial Periods is because the people living in the city and converted to Christianity, were a continuation from the Roman Imperial Period. It is quite natural that the production identified so far belongs entirely to the Eastern Roman Imperial Period. Because the excavated areas and the uncovered spaces are layers dating from the Eastern Roman Imperial Period. It would be wrong to think that local glass production emerged spontaneously in the Eastern Roman Imperial Period. This tradition should be considered as being a continuation from that of ancient times. In the Eastern Roman Imperial period the works of artisan-craftsmen continued to be produced, changing function and shape in accord with the Christian belief as required.

Based on all this evidence, it is certain that glass was produced in Pisidian Antioch in the Eastern Roman Imperial Period. But this production would have developed from an earlier tradition, as mentioned above. Antioch, organised as a colonial city by the Seleucid Dynasty, became the most important pilgrimage centre of Pisidia and neighbouring regions with the Temple and Sanctuary of the Moon God Men. Later it was reorganised under the Roman rule with the Emperor Augustus, and when the reconstruction and construction activities peaked, Antioch became the centre of colonies in the region. In addition to being a military city where Rome's propaganda was made, the Temple of Men and its Sanctuary maintained its importance and the city continued to be a significant religious centre. Saint Paul's visit to the city in 46 A.D. and giving one of the first sermons of the Christian faith here, ensured that the city became a centre of pilgrimage in the first council convened in Nicaea/Iznik in 325 A.D. Production has always been made within the framework of supply and demand in the city which did not lose its importance from the Hellenistic Period onwards and the city's products become popular with new values in different periods. The fact that the city has a large *Territorium* and with all the settlement areas connected to it, it developed as a commercial-manufacturing centre, supporting the idea that local production was carried out in the city to profitably meet the region's needs.

The variety of forms and many techniques used in the production of the glass work in the city showed glass production at Pisidian Antioch not only aimed at meeting the needs of everyday, but also was in an accord with the style and taste of the time. It is possible that in early periods due to The Moon God Men and later St. Paul in the Christian Period, there could have been the use of glass to produce items appealing to the religious beliefs of the pilgrims who came to the city.

When we look at the tens of thousands of glass artifacts unearthed during the excavations in the city, made in very different forms and used for very different purposes; these artifacts, like a mirror, reflect to us the fact that masters of glass working at Pisidian Antioch possessed an extensive repertoire of forms and styles.

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