

Waste disposal in the Netherlands as reflected in shipwrecks of the former Zuiderzee

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Abstract: In 2019 a shipwreck in the Netherlands was re-excavated as part of a training project for archaeology students and volunteers. It was the wreck of a 19th-century pram-like vessel, loaded with a cargo of what seemed to be household waste. However, analysis of the cargo composition showed a different picture. Based on the specialists' investigations it can be stated that the ship's cargo consisted of various components. These can be traced back to different batches of waste, each of which has its own origin. A part of the cargo consisted of household waste, originating from one or a few reasonably affluent households. A second part comprised construction and demolition waste from an urban context. A third component consisted of industrial waste derived from coal gas production. This find may shift the prevailing picture of waste disposal and transport in the Netherlands.

Keywords: 19th-century, pram, composition of cargo, waste disposal, the Netherlands, coal gas production

1. Introduction

The province of Flevoland in the Netherlands is known as the largest graveyard of shipwrecks on land in the world. This province once was the *Zuiderzee*, an inland sea in the centre of the Netherlands. From the Late Middle Ages up to the 20th century, the *Zuiderzee* served as a highway for ships and brought the Low Countries great prosperity (De Vries, Van der Woude 1995: 221–225; Van Holk 2010: 10–14). This all came to an end when in the 1930s the *Zuiderzee* project was initiated: the *Zuiderzee* was closed off by a 32 km-long dam, the *Afsluitdijk* (1932), and parts of the *Zuiderzee* were drained between 1942 and 1968. During the drainage and cultivation of the land over 450 shipwrecks have been found, dating from the 13th to 19th centuries (Van Popta, Van Holk 2018). A total of nine could be identified as vessels carrying a cargo of waste. Eight of them dated from the 19th century.

One of these wrecks, named ZP 5/6, was discovered in 1973 and partially excavated in 1982. The wreck was back in the spotlight in 2019 as part of a training project for students and volunteers in archaeology. In this paper we will explain the different cargo composition of the waste transporters found in the Netherlands, and look into the historical context of waste disposal and transport. Wreck ZP 5/6 and its cargo plays an explicit role in this.

2. Discovery and former research

In September 1973, a shipwreck was discovered when a drainage ditch was further expanded in the agricultural area of the town of Zeewolde. The ditch was situated between the two agricultural lots ZP5 and ZP6, and the wreck found there was named after the location. Some years later, in 1982, the wreck site was partially excavated by members of a youth history association: a team of ten adolescents from the Netherlands and France. Three trial trenches were dug and the ship structure was recorded by hand. Unfortunately, no photos or reports remained; only the field drawing and about 80 finds were preserved. The remaining length of the ship was 17 m and the ship seemed to be loaded with a cargo of waste: a mixture of broken pottery, bone, glass, brick rubble, coal, and pipe bowls. According to the dating of the waste, the ship had foundered somewhere in the end of the 19th century (Van Holk, Overmeer 2024).

3. The field school of 2019

The wreck site was visited again in 2019, because it was the perfect research object for a practical field school. The project was initiated by the Dutch Cultural Heritage Agency (RCE). The main goal was a practical education of young professionals and volunteers interested in maritime archaeology. In addition to teaching the standard excavation methods, the excavation site was visited by experts, giving workshops in photogrammetry, dendrochronology, recognition of ships timbers, micromorphology, geochemical composition of materials and knowledge of post-medieval pottery and bone material. In a period of five weeks' time, a total of 11 students and 11 volunteers were educated (Overmeer, Van der Heiden, Van Doesburg 2024).

In the meantime, the agricultural land on which the wreck was found, had come into the hands of the State Forestry Management (*Staatsbosbeheer*). Nowadays, the wreck is located in the middle of a young forest, the Horsterwold, which produces beautiful, but rather surreal drone images of a wreck in the woods (Fig. 1).

Three trial trenches were planned, which in fact were extensions of the 1982 trenches, or placed adjacent to them. One was positioned at the stern, one amidships, and one at the forward end of the wreck (Fig. 2).

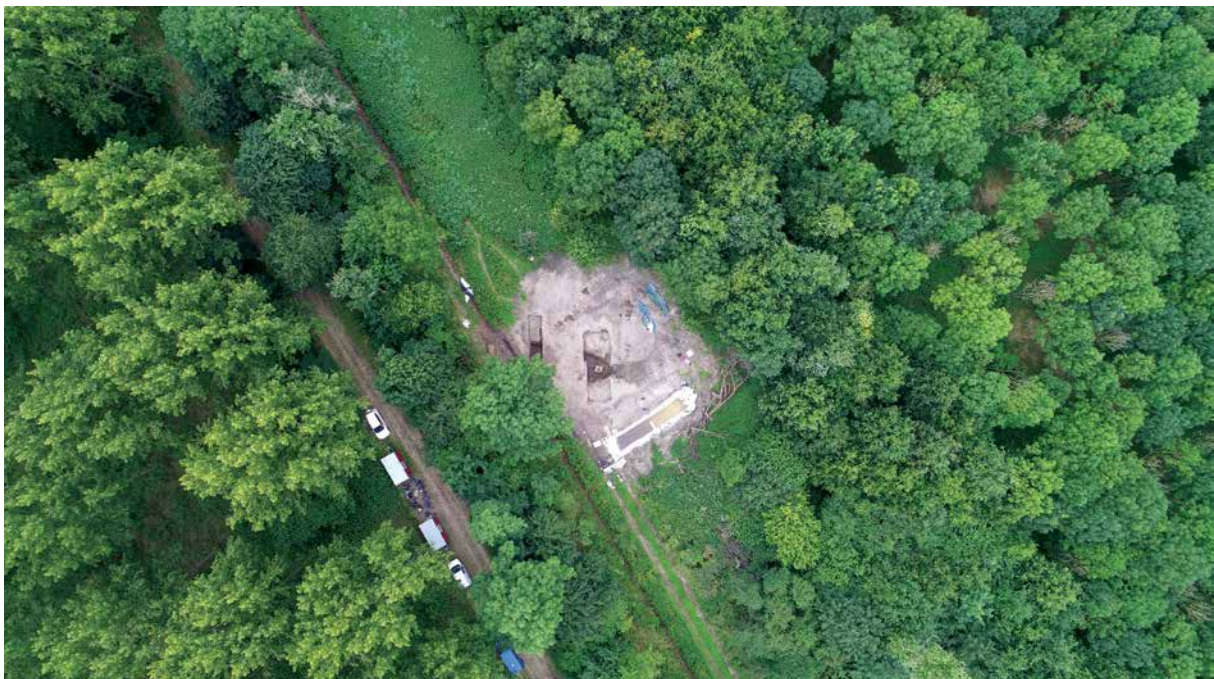


Fig. 1 Drone view of the excavation of the shipwreck in the woods (photo: Cultural Heritage Agency – RCE)



Fig. 2 Overview of the ZP 5/6 wreck, photogrammetry results (authors: T. van Damme, J. Opdebeeck, Cultural Heritage Agency – RCE)

4. Results

4.1. Ship Structure

The 2019 expedition showed that only 16.3 m of the wreck remained (Overmeer 2024a). Due to the construction, regular maintenance and deepening of the drainage ditch between the ZP5 and ZP6 lots, the stempost and parts of the foreship have disappeared. The sternpost was still *in situ*, but only the iron fittings were preserved. Overall, the wood was in very bad condition, totally soft and rotten. Due to natural processes, mainly the fluctuating ground water level and biological processes such as fungi and bacteria, the higher parts of the wreck had decayed.

The ship had a lance-shaped bottom, which was flat and carvel-laid. It had no keel, but a central bottom strake instead (w: 31.7 cm, th: 4.2 cm). On either side of this central bottom strake, five ‘normal’ carvel-laid strakes were placed. The planks were between 3.5 and 5 cm thick and varied in width from 12.5 to 39 cm. The vessel had a hard chine, meaning that the first side strake was attached to the outer bottom strake at a sharp angle of about 113° to 125°, by means of iron nails.

Only the lower side strake was preserved: it had a maximum width of 38 cm and was 3.5 cm thick. The other side strakes were not preserved. It was not possible to determine whether the sides were carvel-laid or clinker-built.

The sternpost aft in the ship seemed to have been reasonably preserved in 1982, but in 2019 there was hardly anything left of the wood. The post only consists of some remnants of rotten wood and two iron U-profiles. These are the iron fittings that connected the sternpost, central bottom strake and skeg. The dimensions of the fittings show that the sternpost once had a lower width of 39.5 cm and a thickness of 11.5 cm.

A 2.5 m long skeg was still present. At the stern it was 10 cm thick and 10.5 cm wide, but at the fore end it ended in a lip with a remaining thickness of 0.5 cm and a width of 14.5 cm. It was fastened to the bottom and the sternpost with small iron nails.

The framing system was composed of floor timbers, extended by knee-like first futtocks in the bilges. They were fastened to the bottom strakes with wooden trenails of 2.5 to 3 cm in diameter. In the sides, the frames were connected to the side strakes by means of iron bolts or nails.

On top of the floor timbers a 32 cm wide and 1.4 cm thick central plank was laid. Most likely this was the keelson, although the adjacent ceiling planks had the same thickness. A mast hole has not been found. The ship had a closed ceiling on the bottom, and only one ceiling strake in the bilges. On top of the bilge ceiling strake, small horizontal planks were placed to close off the spaces in between the frames. Furthermore, there are indications that the ship had a gangway, supported by hanging knees. These were seen in 1982, but in 2019 these higher parts had decayed.

4.2. Layout of the ship

Based on the various layers and the find material in the ship, we can say that the internal space of the ship was divided into at least two, presumably three, different compartments. Aft in the ship was the cabin, which was used as kitchen and living quarters. It must have been a cramped room, not much larger than 3 × 3 m. In the centre of the cabin was a hearth place, consisting of a horizontal iron base plate of 75 × 63 × 1 cm and a vertical iron plate of 75 × 77 × 1 cm (Fig. 3). To either side of the hearth, vertical wooden boards were attached, covered with copper plates. A stove or furnace may have been placed on it, but it may also have been a fireplace, of which the wooden frame and chimney are missing. Many peat bricks were found next to it, in very bad condition.

The find material in the stern area consisted of household goods and personal items; even the glasses of the skipper or his mate were found. Forward of the cabin was the cargo hold. No physical partition was found separating the cabin and cargo hold, but there was a clear difference between the soil layers in the stern area and a characteristic dark waste layer in the hold. It is plausible that the two compartments were separated by a wooden partition or a cupboard wall, but nothing as such has been found. The hold was at least 11 m long but was probably longer. The width of the hold was 3 m on the bottom, increasing to about 4 m at the waterline (Overmeer 2024b).

It is likely that the fore part of the ship was used as fore cuddy, a compartment used for storing tools, sails, and extra rigging, which could also serve as the living quarters of the skipper’s mate. However, this is an assumption, as the fore part was severely disturbed by the drainage ditch.



Fig. 3 Trench in the stern of the ship, with the hearth place in the centre (photo: Cultural Heritage Agency – RCE)

4.3. Ship type and dating of the wreck and finds

The main characteristics – a lance-shaped bottom, a hard chine, a straight raking stern, its dimensions and the find material – all lead to the conclusion that wreck ZP 5/6 was a pram-like vessel from the last decades of the 19th century (Fig. 4). It probably had a length of over 18.5 m, a width of 4.15 m and a depth of about 1.5 m.

Twelve samples of the ship construction were taken for dendro-analysis. Unfortunately, none of them could be dated. The find material dates roughly between 1850 and 1880, with the youngest dated pottery being made between 1876 and 1886 (Van Doesburg, Van Egmond 2024).

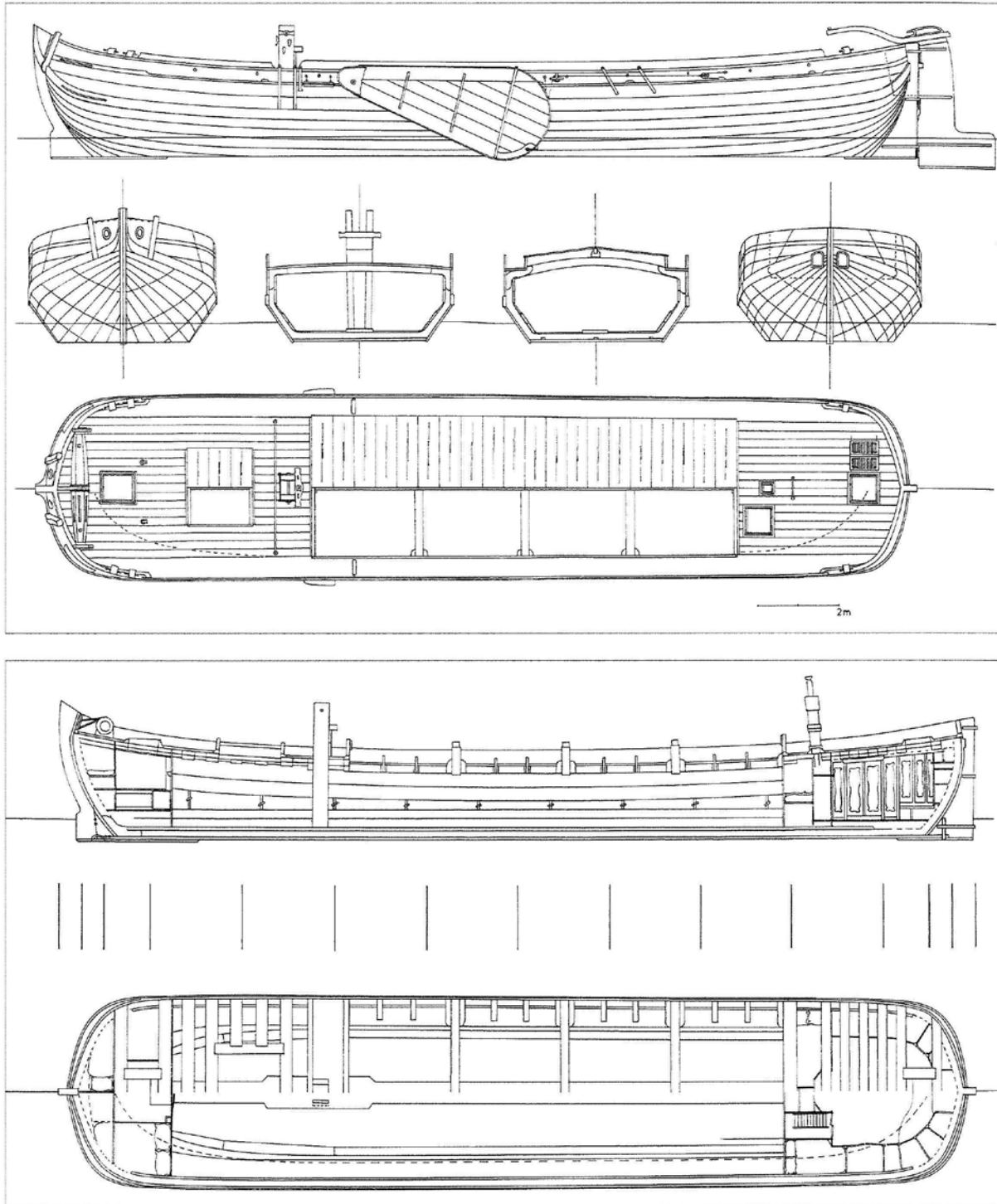


Fig. 4 Reconstruction plan of a large pram (drawing: Schutten 2004: Fig. 2.16)

4.4. Composition of the cargo

The composition of the cargo of wreck ZP 5/6 is remarkable and raises some questions. In 1982 part of the cargo was salvaged. It was composed of a great variety of materials, which initially could visually be identified as the contents of a cesspit (Fig. 5). So, it was thought that the vessel transported city waste, consisting of street sweepings, the contents of cesspits, hearth-ashes, and household waste.



Fig. 5 Waste consisting of different kinds of broken ceramics from the cargo of ZP 5/6 (photo: A. van Holk)

In the 2019 excavation, the cargo was sampled and sieved and additionally investigated by two scientific techniques: micromorphology and XRF (X-ray Fluorescence). The results of the sieving work, the micromorphology and XRF seem to point in different directions. A part of the cargo consisted of household waste, like ceramics, glass, clay pipes and bone material, originating from one or a few reasonably affluent households. A second part comprised construction and demolition waste from an urban context. A third component consisted of slag, cokes and coal; presumably industrial waste derived from coal gas production. Also, the many detected leaves indicate that street sweepings formed an important component of the cargo. The XRF analysis showed that the cargo contained high concentrations of heavy metals, especially lead, and almost no phosphate (which would be expected in the case of dung). The first question is: why this waste was transported by ship to somewhere else?

4.4.1. City waste

First of all, city waste was used as dung on poor soils. In the northern Netherlands peat was dug on a large scale. The sandy soil that remained was barren and needed a lot of dung to make it suitable for agriculture (Van der Veen 1992: 21). Per hectare, around 100 t of city waste was needed to make the soil fertile. The price of dung per shipload of 17.700 kg rose between 1767 and 1878 from fl. 23.90 to fl. 77.84 (Keuning 1989: 111–112; Van der Woud 2007: 229). The only way these enormous amounts of city waste could be transported was across water (Van der Woud 2007: 230).

Most of the peat was used as fuel and was transported by ship to the western part of the Netherlands, as discussed by Wouter Waldus elsewhere in this volume (Waldus 2024). As a return cargo, city waste was taken to the north. The hunger for dung was so great that on Sundays during the church service the pastor would announce the dung auctions of the next week. As a consequence, ships lined up in enormous traffic jams in the *Veenkolonieën* (a peat district in the province of Groningen, in the northern part of the Netherlands) (Keuning 1989: 112–113; Van der Veen 1992: 22). So, city waste was transported on a large scale. Eight other shipwrecks found in the province of Flevoland (the former Zuiderzee) have a cargo consisting of city waste (Tab. 1).

Garbage barges in the province of Flevoland		
Lot	Size	date built/wrecked
NK 7	19.5 x 4.3 m	../19b–20a (around 1900)
NS 101	unknown	../20a
OB 13	9.3 x 2.5 x 0.5 m	../17b (on the basis of the artefactual inventory)
OC 52	18–20 x 3.9 m	../19c (coin William II of 1846)
OH 60	22 x 5.5 m	../18d (coins: after 1788)
OH 71	18–20 x 3.9 m	../19d
OLnn	no data	../1890–1900
OO 2	18–20 x 4 m	../19B (coin, Netherlands 1/2 cent from 1822)
ZP 5/6	18.5 x 4.5 m	19d/20a

Table 1 Findspot, size, and date of nine garbage barges excavated or still present in the province of Flevoland (b = second quarter of a century; B = second half of a century).

The ships, except for one, are comparable in size (around 20 m) and in date (second half of/end of the 19th century). In the second half and especially at the end of the 19th century, on the demand side, the intensified long-distance transport of city waste was caused and made possible by the increase of arable areas in the peat districts in the Northern Netherlands, reflected in the increased price of city waste.

Next to that, on the ‘production’ side, infectious diseases such as cholera and typhus became pandemic in the 19th century. There was a bad vicious cycle of drinking ground or canal water coupled with the discharge of infected stomach and intestinal contents into the same water. Canal water in the 19th century could become lethal for thousands of city dwellers (Van der Woud 1987: 398, 401). Slowly the idea gained ground that waste and drinking water had to be separated.

One of the wrecks with a cargo of waste dates from the 17th century and is half the size of the other vessels. It has a low freeboard of 0.5 m and no mast, so this working-vessel was not suited to sail the Zuiderzee (Reinders *et al.* 1984: 35). In the 16th century, houses in Amsterdam had lavatories that drained into pits, which were emptied at night. Early in the morning, barges sailed with this waste to the river IJ, where they were emptied (Faber *et al.* 1973: 267). Probably this barge broke loose and drifted away to founder in what today is the province of Flevoland (the former Zuiderzee). So already in the 16th and 17th century there was some awareness that waste had to be disposed of outside of the city.

4.4.2. Waste from the production of coal gas

If we consider the results of the XRF analysis and the sieving work, we could launch another hypothesis about the cargo. A significant part of the cargo consisted of slag material (from the combustion of coal and charcoal), heated natural stone, cokes, coal and charcoal (Fig. 6). All of these products are generated during the production of gas for light from coal in a gas factory (Van Os 2024).

In the second half of the 19th century, a revolution took place in the Netherlands with regard to the illumination of streets: the introduction of gas lanterns. Before that time, only some streets or dangerous or important points were illuminated (for example in the provincial town of Assen only the City Hall was, symbolically, lit by a candle in a lantern) (Van der Woud 1987: 417). When it was misty, ropes were put along the canals in Amsterdam to prevent people from falling into the water (Van der Woud 1987: 413–414). It was darkness all around!



Fig. 6 Coal ashes and slag from the cargo of ZP 5/6, waste associated with gasworks and some pieces of slate (photo: A. van Holk)

Gas for street lanterns was produced from coal. Waste associated with former gasworks include amongst others coal, ashes, and slag. At first, this waste was used to fill ditches near the gas factories (Urbanus 2008: 9–10; Pol 1982; De Vries *et al.* 2003). Later on, the waste was used to raise peat bogs in Holland and Utrecht (Van Zon 1987: 160). In Dutch, these raised grounds are called *toemaakdeken*. Many of these terrains are still polluted today by heavy metals and are of serious environmental concern (Rietra, Römkes 2007: 10–11; Marmos Bodemmanagement 2014: 15–16).

4.4.3. Mixed waste composition

The first interpretation of the cargo as remains from a cesspit was based on the fact that only the visible archaeological objects of the cargo were collected. Through the XRF examination it became clear that the chemical composition contained almost no phosphate, but high concentrations of heavy metals. The intensive sieving work revealed that the cargo consisted of a combination of household waste, construction rubble and industrial waste. Micromorphology provided a picture of the cargo consisting of different batches of waste from different sources, which were loaded into the ship in small units, for example with buckets, wheelbarrows or cart loads. They all show the important role of scientific study in archaeology.

The presence of the household waste can possibly be explained by the fact that the manager of a gas factory was obliged to live next to the factory, so he could immediately intervene in case of a dangerous situation (Fig. 7) (Waszink 1996: 77). In this case, it is possible that the waste of the manager's household got mixed up with the waste of the gas factory.



Fig. 7 Company house (to the right) next to a gas holder (to the left) at the Haarlemmerweg in Amsterdam (photo: Cultural Heritage Agency – RCE, Amersfoort/ 232.669)

However, perhaps a more obvious explanation for the composition of the ship's cargo is that it consisted of different batches of waste, the main ones being construction and demolition rubble from a city, industrial waste from a gas factory, and household waste from the factory manager or from other reasonably affluent households in the city. The different kinds of waste simply got mixed in a waste dump (in the vicinity of a city?).

4.5. Conclusion

From the main characteristics – a lance-shaped bottom, a hard chine, a straight raking stern, its dimensions, and the find material – it could be inferred that the wreck of ZP 5/6 was a pram-like vessel from the last decades of the 19th century. It probably had a length of over 18.5 m, a width of 4.15 m, and a depth of about 1.5 m. Based on the find material, the ship's sinking can be dated between 1876 and approximately 1880.

The cargo of the wreck was a mixture of different batches of waste from different sources. A part consisted of household waste from one or a few reasonably wealthy households. Another part comprised construction and demolition waste from an urban context. A third component consisted of industrial waste derived from coal gas production.

Towns had to dispose of their waste from households as well as from industries. The shipwrecks in the former Zuiderzee seem to show that at first waste was mainly reused or dumped nearby, but in the long run it was transported further away to be dumped or reused. The transport of waste across the Zuiderzee shows a clustering in the dates of the ships wrecked towards the end of the 19th century. From the demand point of view – as the demand for dung rose – it became economically profitable to transport city waste over long distances.

The cargo of ZP 5/6 shows it was also profitable to transport industrial waste from the production of coal gas. The chemical composition of the waste makes it probable that, instead of being used as dung on arable fields, it was intended for foundations, raising or paving yards and roads or filling ditches or other depressions.

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