Implications of crushed pottery in prehistoric pottery

This contribution presents an experiment attempting to address the problem of loss of ceramic material as grog when used by prehistoric societies in the production of new pottery.

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The use of grog, crushed pottery used as temper, has been a part of pottery manufacturing from the beginning of pottery manufacture to the present. In prehistory grog presence in matter is a feature of many cultures. The use of this material can be purely practical but we also have to allow for reasons related to the spiritual concepts of prehistoric populations.

Starting points

While analysing ceramic finds from a long term research of the Neolithic settlement at Mohelnice (Moravia, Czech Republic) members of the research team gained a subjective impression that the majority of about 90,000 pottery sherds contained crushed pottery fragments. This developed into a discussion on the possible impact on the interpretation of the archaeological material. If the presence of large volumes of grog is confirmed, it would be necessary to consider the ‘shredding’ of large amounts of pottery during the Neolithic. As a result much of the pottery would not have entered the formative processes and therefore the archaeological record. This would surely affect archaeologists’ conclusions about any given site. We have to state though that archaeologists only estimate the proportion of ceramic remains transferred from a living culture into the archaeological culture to about 1 to 10 %.

Use of grog in various periods

At the moment our knowledge of grog use is based on the analyses of about 2,000 microscopic mounts with ground sections of pottery from the late Palaeolithic to modern times from the Czech Republic. During the Neolithic we commonly found an admixture of pottery fragments, although not as often as in the Aeneolithic. In the Bronze Age and the Early Iron Age, grog appears usually in storage jars and vessels of rough shape. During the Late Iron Age grog was used only in some regions. In Eastern Slovakia there has been observed an interesting phenomenon of adding crushed graphite pottery into sandy pottery. During the time of the Roman Empire grog appears rarely. During the Middle Ages this phenomenon appears only in certain production centres. During the High Middle and New Ages crushed highly fired pottery is used to temper kiln furniture – for example crucibles.

Possible reasons for grog use

The use of crushed pottery as temper can be due to a number of reasons. One of them is the lack of suitable temper materials within a region. Unsuitable materials can cause the cracking of walls, the flaking of surfaces and considerable colour changes. For this reason the easiest solution would be the crushing of broken pottery and using it as a temper. Such temper has a similar characteristic to the new pottery and improves the quality of the vessels. The main advantage of this temper is the fact that it considerably lowers the weight of the pottery in comparison to pottery using a mineral temper.

The use of grog may also have been caused by a need to dispose of pottery waste in a settlement or during production so that it may be possible to consider ‘ecological’ aspects to this phenomenon but we also have to allow for reasons related to the spiritual concepts of prehistoric populations.

We also have to admit the possibility that in some prehistoric cultures pottery fragments entered the new pottery by chance.

Exact research of ceramics containing crushed pottery

In this study we concentrated on the technological significance of grog and attempt to explain the phenomenon by scientific methods. At the beginning we would like to present some basic terminology of pottery technology in connection with the given problem.

Pottery matter is created with two basic components – temper and matrix. Temper is a clastic component consisting mostly of sand (0.05 – 2.0 mm) and less often of grit grains (2.0 – 10 mm). To de-
The number of pottery sherds entering the process or vessels exiting is not important for the experiment although they show clearly the amount of sherds (every archaeologist has his or her idea if it is a lot or little) and ‘recycled’ vessels. The relative volumes of grog and ceramic mixture for the making of the new vessels are the important variables. The proportion of the two volumes represents the behaviour of grog in the experimental sample.

The aim of the experiment was to compare the chosen amount of grog in the experimental sample with the amount in the original sherds of LBK and Lengyel pottery from Mohelnice. This analysis took place in Brno at the Institute of Archaeology and Museology, Philosophical Faculty of Masaryk University and the Institute of Geology, Faculty of Science of Masaryk University.

Comparison of grog content

Two samples of pottery made in CEA Všestary were sent for analysis. In one case the sample contained a small amount and in the other a large amount of grog (Fig. 6). The samples were not fired but the characteristics of grog in the dried sample were recorded. After preparing ground sections from the dried samples, these were fired in the laboratory kiln at the temperature of 900°C for four hours. (Note: generally the temperatures of prehistoric pottery firing were between 600 and 700°C. We chose the top temperature limit for pottery firing as it can be presumed that this temperature can affect the characteristics of the pottery more).

The results of analysis of experimental samples were compared with the results from an analysis of more than 60 pieces of prehistoric pottery made within a grant project aimed at recording the finds from Mohelnice. Most of the ceramic finds analysed consisted of Neolithic pottery and within all levels of LBK the pottery contained fragments of crushed pots.

### Table 1

<table>
<thead>
<tr>
<th><strong>LBK</strong></th>
<th></th>
<th><strong>Lengyel culture</strong></th>
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</tr>
</thead>
<tbody>
<tr>
<td><strong>Volume of crushed pottery:</strong></td>
<td>0.48 l</td>
<td><strong>Volume of crushed pottery:</strong></td>
<td>1.20 l</td>
</tr>
<tr>
<td><strong>Volume of ceramic mixture:</strong></td>
<td>1.33 l</td>
<td><strong>Volume of ceramic mixture:</strong></td>
<td>1.33 l</td>
</tr>
<tr>
<td><strong>Approximate ratio of experimental volumes:</strong></td>
<td>1:3</td>
<td><strong>Approximate ratio of experimental volumes:</strong></td>
<td>1:1</td>
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**Ratio of volumes of original pottery:**

- In LBK sherds were identified as around 5-10% of the determinable pottery fragments, the original volume of grog could have been higher, but could not be determinable with optical microscopy due to the presence of fine particles.
- In Lengyel pottery siltstone and slate was macroscopically confused with pottery fragments. Their volume in the sherds was about 15%.

The proportion of the two volumes represents the behaviour of grog in the experimental sample.

**Experiment**

To develop our ideas on the possible impact of ‘shredding’ pottery material a simple experiment (Fig. 5) was carried out in the Centre of Experimental Archaeology in Všestary (CEA). It consisted of crushing a measured volume of pottery sherds and working it into a known volume (two cubes) of ceramic matter (one of these is shown in Fig. 4). From these, several replicas of Neolithic vessels were made (Fig. 3).

To allow for a comparison we chose two different volumes of grog (Fig. 1 and 2) which should hypothetically corresponded with the use of grog within two Neolithic cultures: LBK and Lengyel culture. Each amount was worked into a cube of clay of 11 cm to a side. From one (LBK) we made two rounded vessels (Fig. 3: the two dark vessels on the right), from the other (Lengyel culture) four vessels (Fig. 3: the four light vessels on the left).

The sherds of pottery were crushed with replica stone grinders. The result was a mixture of various coarseness from clay dust to small sherds subjectively corresponding to the size of pottery fragments in the original prehistoric pottery. The resulting volume was measured by pouring the crushed pottery into a measuring jug.
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The mentioned experiment was supposed to reconstruct the production process. The ground sections of experimental samples were supposed to show to what degree the reconstruction succeeded. The comparison of microstructures of experimental samples and LBK sherds (Fig. 8, 9) shows that the admixture of crushed pottery had to have entered the matter in a different way.

The pottery fragments contained in the ceramic finds from Mohelnice had rounded edges which would indicate that they were weathered and may have entered the matter by chance. Clay for Neolithic pottery production was probably taken from building pits beside the post-built houses. The seasoning of the material, which affects the characteristics of the ceramic mixture positively, may also have taken place in these pits. Ethnographic studies show that this process can take up to several decades. The actual time of seasoning is not possible to determine, it can only be suggested by certain signs. For example charred leaves and roots in the pottery matter could be evidence of long term seasoning, although other explanations are possible. Under the influence of atmospheric conditions harmful matter breaks down and the clay homogenizes. If broken pottery appeared in the same pits it is possible that it disintegrated over winter and the remains entered the material and are still microscopically (occasionally even macroscopically) recordable in finds. In sherds of the LBK it is estimated that crushed pottery made up to about 5% of the overall volume of matter. The Lengyel sherds from Mohelnice contained numerous red and grey fragments, up to 5 mm large (Fig. 10, 11) which were macroscopically interpreted as grog. Microscopic analysis of ground section mounts showed that these were fragments of slate and siltstone.

Conclusion

The experiment failed in reconstructing the production process of LBK and Lengyel pottery as presented in the finds from Mohelnice. The analysis though did eliminate the use of grog in Lengyel pottery, the observed phenomenon being fragments of crushed siltstone and slate which look similar to pottery. In LBK the presence of pottery fragments was probably due to causes other than deliberate tempering, in all likelihood a result of contamination of the clay during the process of seasoning. On the other hand the experimental samples from Všestary are, in its character, close to Baden culture pottery (Aeneolithic) where grog often appears. This is shown by micropetrographic analysis of pottery from Těšetice-Kyjovice and Hlinsko where this sort of temper appears in nearly every sherd. The fragments in the Baden pottery have relatively sharp edges and are quite big. They make up to 15% of matter and occasionally more. That brings up the question that if this culture ‘recycled’ its pottery how does this reflect on the study of its fragments.

Even after this experiment, the risk of prehistoric pottery ‘shredding’ is not unambiguously clear. Our experiment shows that we can model the situation where a volume of crushed pottery is added to a larger volume of clay, absorbing a significant amount of pottery fragments. However it must be admitted that the exact volume cannot be determined even with microscopy. This is because when crushing pottery, a very fine dust fraction, not determinable by optical microscope because prehistoric and experimental pottery is fired in relatively low temperatures, develops. These fine particles when mixed with damp ceramic mixture rehydrate and merge into the surrounding matrix.

As was mentioned above, archaeology has to consider a number of obstacles presented by the formative processes. If the risk discussed in this contribution adds to them, we should respect it despite the difficulty of creating means of identifying it.
Possible implications of crushed pottery presence in prehistoric pottery

Summary
Schlussfolgerungen aus der Existenz zerschlagener Keramik (Schamott) in ursächlichen Keramikgefäßen


Durch dieses Experiment konnte nicht der Herstellungsprozess der bandkeramischen und lengyelzeitlichen Keramik, wie sie aus den Funden von Mohelnice bekannt ist, rekonstruiert werden, die Analyse ergab nämlich, dass das in der lengyelzeitlichen Keramik beobachtete Material nicht Schamott, sondern zerkleinerter Sandstein und Schiefer waren. In den bandkeramischen Gefäßen scheint außerdem die Existenz von Schamott andere Gründe als eine absichtliche Magerung zu haben; vermutlich handelt es sich dabei lediglich um eine beim Magern unbeabsichtigt entstandene Verunreinigung.

Andererseits entsprachen die für das Experiment hergestellten Proben weitestgehend der Zusammensetzung von Keramik der aneolithischen Badener Kultur, wie sie aus den Funden der Siedlungen von Tesetice-Kyjovice und Hlinsko bekannt ist.


Poterie à débris de terre cuite
En étudiant la céramique provenant du site néolithique de Mohelnice (Moravie, République tchèque), fouillé systématiquement dans les années 50 et 60 du siècle dernier, les auteurs sont arrivés à une impression subjective que la plupart de 90 milliers de tessons contiennent des débris minuscules de terre cuite. Cette constatation a produit une discussion au sujet d’influences potentielles sur l’interprétation archéologique. Afin d’avoir une certaine idée sur un impact potentiel de ce „rejet au rebut“ céramique, on a effectué une petite expérimentation consistant en broyage d’une quantité connue de tessons et en leur incorporation dans une certaine quantité de pâte céramique. A partir de cette préparation, on a fait des échantillons qu’on a soumis à une analyse micromorphologique. Les résultats obtenus ont été comparés à ceux issus des analyses faites sur des tessons originaux.

Cette expérimentation n’a pas permis de reconstituer le vrai procédé de fabrication de la poterie linéaire et de celle de Lengyel, tel qu’il s’agit sur les pièces de Mohelnice. L’analyse a éliminé l’utilisation du dégraissant en terre cuite pour la céramique de Lengyel où les particules observées sont en ardoise. Puis, il est probable que la présence de débris en terre cuit constatée sur de la céramique linéaire a été due à d’autres facteurs qu’à l’addition volontaire du dégraissant (peut-être à la contamination de l’argil au cours de la maturisation). Par contre, les échantillons expérimentaux ressemblent beaucoup à la céramique de la civilisation de Baden découverte sur les sites de Těticetice et Hlinskó (République tchèque).

Cette expérimentation met en évidence que ni analyse micromorphologique ne permet déceler la quantité précise de débris de terre cuit parce qu’en broyant des tessons, on produit une très fine fraction poudreuse dont des particules minuscules se fondent en liant et ainsi, elles ne sont plus perceptibles.

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Martin Hložek studied the chemistry of materials and archaeology. He currently concentrates on the application of natural scientific analysis to the research of ceramic artefacts.