



Graça Filipe*

***The safeguarding of the Vale de Milhaços Gunpowder Factory
and the operational conservation of the steam generator
and the steam engine***

***Zabezpieczenie fabryki prochu w Vale de Milhaços
oraz konserwacja generatora pary i silnika parowego***

Contextualizing the site and the project

The heritagisation of the Black Gunpowder Factory Circuit in Vale de Milhaços¹ and the museum project that brings it into association with the Seixal Municipal Ecomuseum constitutes a paradigmatic and landmark case in Portugal: the safeguarding of an industrial site undergoing a scenario of deindustrialisation, fully converting this heritage site for public enjoyment and reutilisation (Fig. 1).

The recognition of the heritage value of the core cluster of buildings of the Vale de Milhaços Gunpowder Factory took place towards the end of its operational life (in the 1990s and early years of this century) and ensured the establishment of the minimum conditions for its transition to heritage management under municipal supervision [1], [2]. It is this management, irrespective of all of the inherent difficulties due to the scale of the site and the overall shortage of resources for its protection, that seeks to reconcile the reutilisation and participation in the site with the implementation of a conservation, study, documentation and mediation project. The museum program drafted at the launch of the project opted unequivocally for the operational conservation of the integrated movable heritage and attributed specific importance to the steam-powered generation equipment [3].

This option raises relevant conceptual and methodological questions and the practical experience acquired over various years confirms the need for multidisciplinary analysis spanning a broad range of reflection in order to design and conceive the future valuation and safeguarding heritage program.

The production of black gunpowder in Vale de Milhaços began in 1896 in a steam engine powered facility [3], [4]. However, in 1897, a serious accident partially destroyed the raw materials processing workshops and led to the deaths of various employees. In 1898, following recapitalisation and the launching of a new business, a new factory was built while taking advantage of some of the surviving original structures. With investments in new buildings and production equipment, adapted to the French and Germany models, there was a significant technological step forwards.

The production structure relied on an innovative system for transmitting mechanical energy over distance and interconnecting the central building with transmission houses for eight sets of buildings each containing their own production workshops. This innovative system installed in Vale de Milhaços followed some of the characteristics of other important factories of that time, such as those of Barcarena (Portugal) and Sevran-Livry (France) [5], [6].

With a corresponding need for greater energy production, both thermal and mechanical, a new boiler was installed (in 1898, the Pierre Dumora brand) and a steam-engine with a greater capacity (in 1900, the Joseph

* ORCID: 0000-0003-1317-0159. Ecomuseu Municipal do Seixal, Portugal.

¹ Vale de Milhaços belongs to the municipality of Seixal, district of Setúbal, in Portugal.



Fig. 1. Vale de Milhaços Gunpowder Factory, aerial view (© Municipal Ecomuseum of Seixal – Documentation and Information Centre and Rui Dias, 2018)

Il. 1. Fabryka prochu Vale de Milhaços, widok z lotu ptaka (© Municipal Ecomuseum of Seixal – Documentation and Information Centre and Rui Dias, 2018)

Farcot brand imported from France) with an output of 125 CV².

In 1911, another new boiler (nationally produced by the João Peres brand) was installed to definitively replace the original factory boiler.

This spanned the entire range of infrastructures necessary to the chain of production, capturing and supplying water, safety spaces between workshops, support services and with other buildings holding social and habitational functions with the Vale de Milhaços Gunpowder Factory covering an area of some 20 hectares.

In 1899, Companhia Africana de Pólvora produced 439 tons of gunpowder, thus even exceeding the average forecast level of production (Fig. 2).

In the mid-1990s (and well after the loss of the colonial market in the 1970s), Sociedade Africana de Pólvora continued to search for alternatives to ensure its survival in the European marketplace, submitting its black gunpowder to certification and the regulatory framework established by the European Union directive in effect from

1993 onwards. This certification did ensure that its products would remain on sale into the 21st century.

With the industrial plant factory diagram of 1898, production continued through to 2001 with recourse to steam for the production of the energy necessary to drive the 19th century equipment.

The heritage on the black gunpowder circuit was recognised and duly inventoried between 1998 and 2001 by a scientific and technical team set up by the Seixal Municipal Ecomuseum in collaboration with the management and workers at the factory.

The Ecomuseum is a museum entity established in 1982 under the auspices of Seixal Municipal Council and has, ever since 1996, worked on a project to inventory and study the local industrial heritage.

In 2001, the Gunpowder Circuit was attributed to the Municipal Ecomuseum, as an extension, with the objective of ensuring the management of the site where Seixal Municipal Council sought to guarantee the preservation of the heritage, which includes not only all the production machinery, equipment and utensils but also the immovable heritage, thus over two dozen buildings with varying and distinctive architectonic and built characteristics.

² Corresponding to 123,287 horse-power.

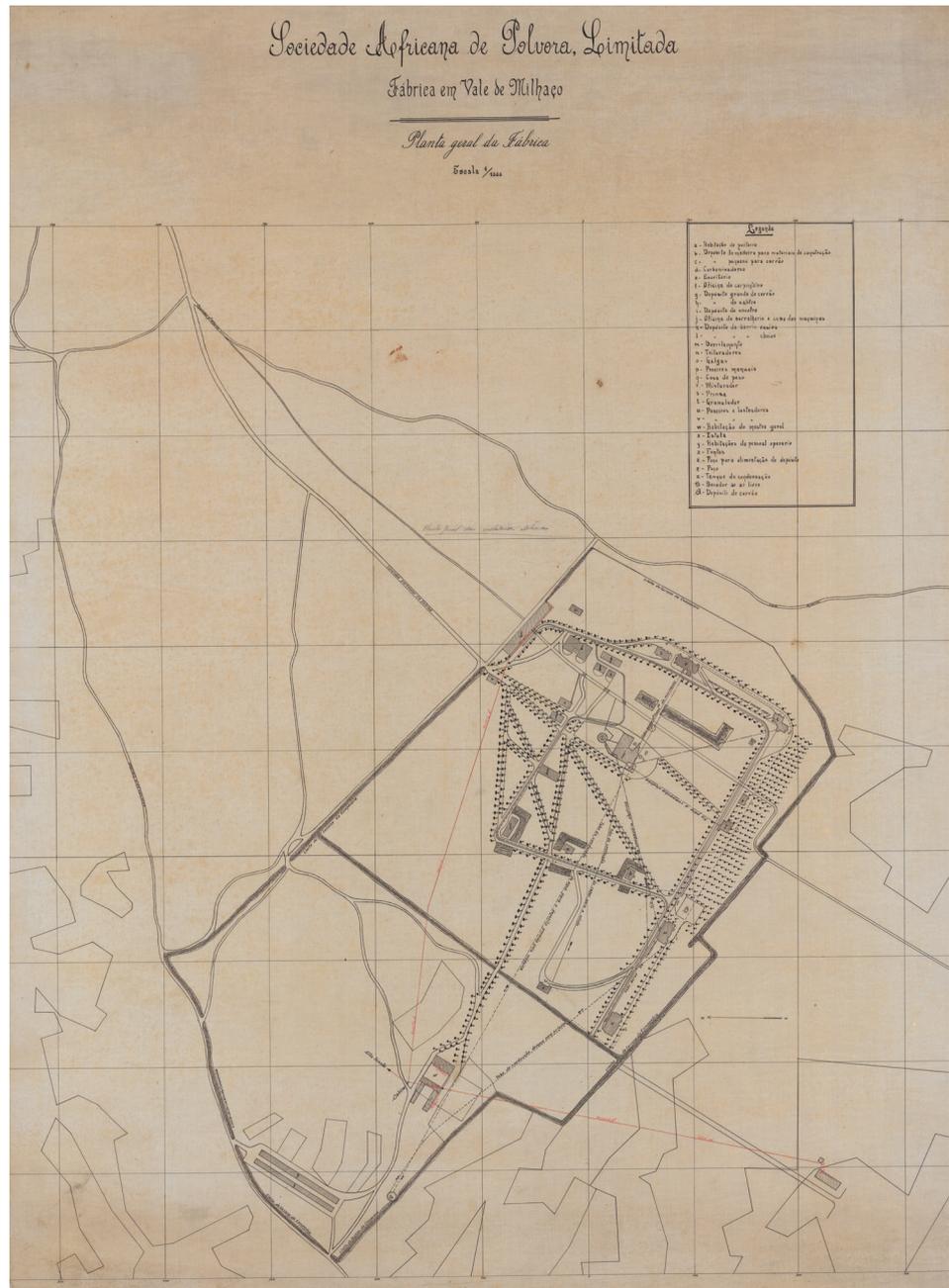


Fig. 2. Vale de Milhaços Gunpowder Factory, factory plan, 20th century (© Municipal Ecomuseum of Seixal – Documentation and Information Centre)

Il. 2. Fabryka prochu Vale de Milhaços, plan fabryki, XX w. (© Municipal Ecomuseum of Seixal – Documentation and Information Centre)

The central set of buildings contains the steam generating boilers and steam engine. Also still making up part of this heritage set is the system of teledynamic cables that ensures the transmission of mechanical energy from the central building – powered there by the main motor – over a length of over 500 m, to the various gunpowder manufacturing workshops: grinding, mixing and sieving, milling, pressing, corning, sieving and glazing workshops (Fig. 3).

A Decauville type railway line served for the transport of products in wagons, which had bronze wheels for reasons of safety and were moved by human labour over a total distance of over 1100 m.

The final years of operation and the closure of the factory represented a crucial phase in the heritagisation process.

The heritage classification of the Black Gunpowder Circuit was proposed by Seixal Municipal Council to the

competent state entity in 1999. The classification process came to an end in 2012 with the set classified as a Monument of Public Interest (13.4 hectares)³.

Due to vicissitudes and administrative and legal problems, only in 2007 was Municipal Ecomuseum able to begin its management of the site.

Since 2008, within the scope of municipal services that include the Ecomuseum, the Black Gunpowder Circuit has hosted highly diversified cultural initiatives and activities,

³ This legal protection was equally important from the perspective of the management and land planning of the council's territory. In 2015, the Seixal Municipality Directive Plan specifically stipulated the museological utilisation of the cultural heritage made up of the former Vale de Milhaços Gunpowder Factory and correspondingly attributing 13.4 hectares of the Black Gunpowder Circuit to the category Space of Special Usage – Equipment and facilities for collective utilisation.



Fig. 3. Vale de Milhaços Gunpowder Factory, the transmission of mechanical energy by the system of teledynamic cables

(© Municipal Ecomuseum of Seixal – Documentation and Information Centre)

Il. 3. Fabryka prochu Vale de Milhaços, system kabli teledynamicznych do przenoszenia energii mechanicznej

(© Municipal Ecomuseum of Seixal – Documentation and Information Centre)

some maintaining the connection with the former employees and having been attended by thousands of visitors.

The operational conservation

Heritage conservation is a determinant process for sustainability and spans all of the measures and actions that, with due respect for the meanings and the physical properties of such heritage, seek to ensure their safeguarding while simultaneously maintaining accessibility to present and future generations.

In the case of technical and industrial heritage, this prioritises *in situ* conservation [3].

The innovative musealisation program of the Black Gunpowder Circuit of the Vale de Milhaços Gunpowder Factory correspondingly attributed priority to this option through the means of an operational conservation program or of functional reconstitution. The option was only made to remove the heritage and carry out conservation in reserve in extreme cases and in order to guarantee the safeguarding of objects at risk of loss.

Every Vale de Milhaços Gunpowder Factory object with recognised heritage value was subject to incorporation into the museologic collection through means of documentation, inventorying and conservation at the Municipal Ecomuseum of Seixal.

Furthermore, during the industrial period, deactivating the carbonization workshop involved the deployment of an *in situ* heritage conservation program in conjunction with the functional reconstitution of the carbonization furnaces (Fig. 4).



Fig. 4. Vale de Milhaços Gunpowder Factory, the carbonization workshop (© Municipal Ecomuseum of Seixal – Documentation and Information Centre)

Il. 4. Fabryka prochu Vale de Milhaços, warsztat karbonizacji (© Municipal Ecomuseum of Seixal – Documentation and Information Centre)

The thermal and steam engines, alongside the set of energy production workshops they fed, were fully integrated into the operational, and therefore *in situ*, conservation program.

The option for operational conservation led to, in addition to the request for the cancellation of the industrial licence, the Sociedade Africana de Pólvora management submitting a report to the National Police Director, on 18 February 2002, confirming the termination of production of black gunpowder at the Vale de Milhaços Factory while simultaneously requesting authorisation to maintain the production line *in situ* on grounds that highlighted [...] *how there are future plans for this production line to operate but only with the utilisation of inert materials.*

The Vale de Milhaços Gunpowder Factory perimeters, defined for the purposes of the heritage classification of the Black Gunpowder Circuit, took into account the viability of any safeguarding plan while applying selection criteria that considered the historical, industrial and technological importance, the recognition from the community and the potential for valuation. This particularly included the topographic characteristics of the 1898 industrial layout, the uniqueness and longevity of its energy system and the means of production as well as the active transmission of individual memories and technical knowledge.

The entire production line was subject to a systematic cleaning and with the removal of any waste materials that might pose any hazard so as to ensure the opportunity to begin exclusively engaging in managing the site as a museum, which took place from 2007 onwards.

The energy generation system, made up of the steam boiler and the steam engine, constituted one of the core focuses of the preservation project inherently bound up with the necessary technical means and the specialist human resources, in particular the system operators.

The ongoing musealisation project bears special relevance, in conjunction with the legal protection provided through heritage classification, due to the licencing of the pressurised equipment (steam boiler and steam engine) in order to preserve them in an operational state.

Following Seixal Municipal Council having proceeded in 2004, in accordance with the legal norms for pressurised industrial equipment, to register the steam boiler and steam engine as municipal property as part of its museologic assets, as from 2012 this entity took over guaranteeing the renewal of the operational licences of this equipment that remains subject to industrial safety legislation irrespective of the new museum context of operational conservation.

Within the scope of renewing the licensing processes, a record of the knowledge held by former operators and employees was set down and then deepened through bibliographic research carried out by the Ecomuseum's science team. This technical and functional characterisation of the thermal and mechanical energy generation system describes both the maintenance and conservation actions and the technical practices and knowledge for safeguarding. This methodology rests on respect for the procedures that ensure the integrity, authenticity and lon-



Fig. 5. Vale de Milhaços Gunpowder Factory, the João Peres brand steam generator (© Municipal Ecomuseum of Seixal – Documentation and Information Centre)

Il. 5. Fabryka prochu Vale de Milhaços, generator pary marki João Peres (© Municipal Ecomuseum of Seixal – Documentation and Information Centre)

gevity of the industrial plant and the techniques and technical knowledge and practices thereby associated (Fig. 5).

The João Peres brand steam generator

The boiler house contains the João Perez made boiler, manufactured in Portugal and installed in 1911. Throughout around nine decades, this machine produced the steam necessary both to power the steam engine and to dry the gunpowder (with this workshop fed via the steam-duct).

This boiler is currently conserved in an operational status and duly licenced for the Municipal Ecomuseum of Seixal with a 5 bar (rather than the 6.86 bar of the industrial period) capacity and now supplying steam only to the steam engine.

This is a Cornish type boiler with a capacity of 11.45 m³ and a heated surface area of 45 m² able to reach a maximum service temperature of 170 °C. The boiler is wood fuel powered.

The boiler structure for generating steam is complemented by various mechanisms for the supply of water, controlling the pressure and releasing steam.



Fig. 6. Vale de Milhaços Gunpowder Factory.
The Joseph Farcot brand steam engine
(© Municipal Ecomuseum of Seixal
– Documentation and Information Centre)

Il. 6. Fabryka prochu Vale de Milhaços,
silnik parowy marki Joseph Farcot
(© Municipal Ecomuseum of Seixal
– Documentation and Information Centre)

Among the respective boiler maintenance procedures are the water treatment operations and the cleaning of both the boiler and the chimney.

Through to the 1970s, the water for the steam generator was not treated by adding any chemical products, hence sludges and salts would accumulate over the extent of the metallic walls and beginning to corrode them. In order to minimise these destructive processes, small sheets of zinc were placed around the boiler interior in order to pulverise the calcium sulphate contained in water and thereby hinder the formation of incrustations. As zinc is not effective with all mineral salts nor does it impact on the organic materials in water, incrustations then ended up forming and that had to be removed manually from within the boiler.

From the mid-1970s onwards, the treatment of the water for the João Peres boiler was altered through the application of two chemical products designed to ensure the removal of any accumulated detritus over its interior surfaces. This boiler water treatment procedure has since been maintained within the museum context.

As regards cleaning the chimney, while the factory was in industrial production, this work would take place on an annual basis and prior to the summer holiday period thereby removing all of the ashes that had accumulated over the course of the year. On cleaning day, the workers would form a group. Three of the members would enter the chimney flue equipped with a bucket while the other two would remain outside. A short while later, they would switch tasks and continuing to do so through to the completion of this process. The chimney cleaning currently takes place according to the same procedure (Fig. 6).



Fig. 7. Vale de Milhaços Gunpowder Factory,
Francisco Moura lubricating the steam engine
(© Municipal Ecomuseum of Seixal
– Documentation and Information Centre)

Il. 7. Fabryka prochu Vale de Milhaços,
Francisco Moura smarujący silnik parowy
(© Municipal Ecomuseum of Seixal
– Documentation and Information Centre)

The Joseph Farcot brand steam engine

The steam engine house contains a Joseph Farcot brand engine, manufactured in Saint-Ouen (Paris, France) and installed in 1900. Throughout a century, the engine produced the driving force necessary to power the Black Gunpowder Circuit of the Vale de Milhaços Gunpowder Factory.

Currently, this is operationally conserved so as to enable demonstrations of the functioning of its steam powered mechanical energy production and the system for the transmission of movement over distance via teledynamic cables.

The steam engine runs up to 125 CV and with the speed of the flywheel reaching 75 rotations per minute. The engine falls into the category of horizontal, mono-cylinder machines composed of a system of steam distribution valves (Corliss type), for one cylinder or steam receptor, a lubrication system, a movement transmission system, a steam entrance regulator (governor) and a condenser. This is then complemented by a water refrigeration system installed in an external tank.

The lubrication of the machinery and the cleaning and maintenance of the refrigeration tank represent important maintenance procedures.

This also extends to the operational conservation and cleaning and maintenance of the refrigeration tank (Fig. 7).

Licensing the functioning of the boiler and steam engine

The current legal requirements for the renewal of pressurised equipment operational licences are legally stipulated⁴. Based on these legal frameworks, the Ecomuseum

⁴ In Portugal, by Dispatch 22332/2001, dated 30 October with the legal procedures for steam generation licences specifically established by Decree Law no. 90/2010, of 22 July.

undertakes the actions necessary to renewing the licences both for the João Peres boiler and for the Joseph Farcot steam engine.

The certification and subsequent licence renewal procedures for this machinery and its activities were duly identified and constitute essential dimensions to overall operational conservation for purposes of demonstrating the functioning of the pressurised equipment.

This process is submitted to the Instituto Português da Qualidade and correspondingly requesting an inspection.

The boiler inspection undertaken by a competent external organism (currently the Instituto da Soldadura e Qualidade) includes the testing of the hydraulic pressure and the verification of the inner cylinder through direct observation and testing the steam pressure.

In relation to the process of renewing the authorisation for the boiler to operate, this involves the testing of both the pressure and the boiler safety valve by an authorised inspector who, after having confirmed the equipment meets the requirements, drafts a report that is then submitted to the licensing service.

Having confirmed the good operational conditions of the steam generator, an inspection was made of the steam engine and it thus proved possible to obtain the renewal of its licence, the first for a museum context in Portugal, by the same public entity (Instituto Português da Qualidade)⁵.

The pressure gauge – the instrument measuring the build-up of steam – installed and functional in the boiler belongs to the Wika brand and also receives a certificate of periodic inspection (issued by the TAP Laboratory)⁶.

The authorisation for the operating of the Joseph Farcot brand steam engine, built in 1900 (thus not attributed any construction certificate) and with its nominal potential of 125 *cavalos vapor* equivalent to around 92 Kw, falls under the auspices of Decree Law no. 61/2009, of 9 March.

The operating rate for which the João Perez steam generator is authorised is 5-bar taking into consideration the demonstration purpose of the motor system in the Gunpowder Circuit and given that the steam machine is correspondingly no longer used under a production regime.

Following the same legal practice in effect for industrial plant and equipment, the two operating licences are affixed to the buildings housing the boiler and the machine and thus fully available for observation by the users and visitors of the Seixal Municipal Ecomuseum.

⁵ In 2015 and 2016, with the updating of the legal and administrative framework stemming from the new Organic Law for the Ministry of the Economy, enacted in 2014 (Decree Law 11/2014, of 22 January), the entity responsible for the industrial licensing of pressurised equipment became the Portuguese Institute of Quality. This was thus the entity that received the request to renew the boiler licence in 2016 and 2018 and the steam engine in 2017.

⁶ The metrological verification conditions and the issuing of certificate for this equipment, required by the licence for steam generation arises from Decree Law no. 291/90 of 20 September, Decree no. 422/98 of 21 July and Dispatch no 1173/2015 (with the latter valid until 31 December 2017) but which remains applicable.

We would note that periodic pressure testing represents a potentially destructive operation in keeping with its design and goal of revealing any defects existing in the equipment and in itself representing a process of worsening or creating defects in the boiler. Hence, irrespective of such testing being a legal requirement for monitoring the prevailing safety conditions, it should be our objective to minimise such recourse while simultaneously maintaining all of the conservation procedures and tests that are non-destructive to the safety conditions.

The inspections undertaken for the Vale de Milhaços Gunpowder Factory sought to reconcile the operational conservation with the principle of minimum intervention out of respect for the historical background of these objects, especially the alterations they have been subject to over the course of time whenever such do not constitute factors of degradation and corrosion and in addition to the reversibility, stability and compatibility of the materials applied in relation to those already existing.

Conclusions

While we understand the added value that operational conservation does also bring to heritage in terms of its interpretation and mediation, we are nevertheless aware of the technical and human limitations this presents.

The musealisation project has hitherto been able to source machine operators from among the former factory workers, whether through professionally allocating them to the Seixal Municipal Ecomuseum team or through voluntary collaborations. However, we have not yet been able to train any new operators.

Our experience tells us of the need to always have a “plan B” available, evaluating the sustainability of the project for safeguarding and the model for managing the heritage on the Black Gunpowder Circuit of the Vale de Milhaços Gunpowder Factory due for implementation over forthcoming years.

Establishing partnerships with universities and researchers can develop new studies on the industrial heritage, in a multidisciplinary scientific perspective. This is the case of the current project IH4Future – *Material Culture, Scientific Culture: industrial heritage for the future* where researchers from Historical, Museological, Material and Conservation sciences consider the scientific study of the Vale de Milhaços Gunpowder Factory, namely the material characterisation of an important part of the integrated heritage using different analytical techniques. These studies will contribute to assessing the conservation state and to the musealisation process of the Gunpowder Circuit, with scientific-based knowledge on the industry history and technological development.

We are aware of the temporal limits on the process that began with the Gunpowder Circuit and it remains our objective to ensure an alternative plan for its *in situ* conservation. We nevertheless know that the technological value of the Vale de Milhaços heritage is strengthened by its operational conservation and that any other alternatives would hold repercussions impacting on the level of recognition attributed by its visitors and beneficiaries.

References/Bibliografia

- [1] Filipe G., *Património industrial, experiências museológicas y proyectos de intervención en el territorio*, [in:] *Estructuras y paisajes industriales, proyectos socioculturales y turismo industrial*, Asociación de Arqueología Industrial, Incuna, Gijón 2003, 79–87.
- [2] Filipe G., *Circuito da Pólvora Negra de Vale de Milhaços (Seixal-Portugal): patrimonialização e gestão do património*, [in:] M.Á. Álvarez Areces (ed.), *Pensar y actuar sobre el patrimonio industrial en el territorio*, Colección Los Ojos de la Memoria, 19, CICEES, Gijón 2017, 473–480.
- [3] Filipe G., *Fábrica de Pólvora de Vale de Milhaços (séculos XIX–XXI): importância da protecção legal do património industrial e potencialidades da musealização do Circuito da Pólvora Negra*, [in:] E. Vieira, J.M.L. Cordeiro (eds.), *Actas do II Congresso Internacional sobre Património Industrial. Património, Museus e Turismo Industrial: Uma Oportunidade para o Século XXI*, CITAR /Escola das Artes/Universidade Católica Portuguesa e Associação Portuguesa para o Património Industrial 2017, 422–431, <http://citar.artes.porto.ucp.pt/sites/default/files/files/artes/ActasIICongressoPatrimonioIndustrial.pdf> [accessed: 14.03.2020].
- [4] Filipe G., Sabino F., Verissimo F., *Herança de um meio técnico e valorização de um capital de saber-fazer: da pólvora à vitalidade do património industrial em Vale de Milhaços*, [in:] *Museus e património imaterial: agentes, fronteiras, identidades*, Instituto dos Museus e da Conservação, Softlimits, Lisboa 2009, 265–275.
- [5] Quintela A.C., Cardoso J.L., Mascarenhas J.M. de, *The Barcarena Gunpowder Factory: Its History and Technological Evolution between the Seventeenth and Twentieth Centuries*, [in:] B.J. Buchanan (ed.), *Gunpowder, Explosives and the State. A Technological History*, Routledge, London–New York 2006, 123–141.
- [6] Custódio J., *Património industrial da área territorial de Setúbal: a singularidade da Fábrica da Pólvora de Vale de Milhaços*, [in:] *Movimento cultural*, Edição especial, 2014, 18–34.

Abstract

The subject of the article is the black powder factory in Vale de Milhaços in Portugal as an example of the protection of post-industrial heritage. Shown the process of transforming an active production facility into a museum. The steam powered production of black gunpowder in Vale de Milhaços began in 1896 using an innovative system for transmitting mechanical energy over distance by interconnecting the central power generation building with transmission houses for eight sets of production workshops. Steam powered production continued through to 2001 when the Black Gunpowder Circuit became an extension of the Seixal Municipal Ecomuseum under the management of the Seixal Municipality. This aimed to guarantee the preservation of the heritage, including the buildings, production machinery, equipment and utensils. Importantly the heritage was conserved *in situ* with operational steam-powered energy production, using expertise from past workers at the factory. This required multiple technical, administrative and heritage management procedures including heritage classification; registering of the pressurised industrial equipment; renewal of the licenses for such equipment with the respective economic and industrial public authorities (despite being industrially deactivated); contracting operators for their appropriate conservation within a museological context; and eliminating all black powder from the buildings and surrounding areas. Partnerships with universities and researchers were also developed, including the current project IH4Future – Material Culture, Scientific Culture: industrial heritage for the future under which researchers from historical, museological, material and conservation sciences are undertaking the material characterisation of the heritage on the site using multiple analytical techniques. These studies will provide knowledge on the industry history and technological development of the Vale de Milhaços Gunpowder Factory that will assist in its conservation and development as a museum.

Key words: Vale de Milhaços Gunpowder Factory, industrial heritage, steam generation, steam engine, operational conservation

Streszczenie

Tematem artykułu jest fabryka czarnego prochu w Vale de Milhaços w Portugalii jako przykład ochrony dziedzictwa postindustrialnego. Ukazano proces przekształcenia czynnego zakładu produkcyjnego w muzeum. Produkcja za pomocą maszyn parowych rozpoczęła się tam w 1896 r. Wykorzystywano innowacyjny system do przesyłania energii mechanicznej na odległość przez połączenie budynku centralnej siłowni wałami przesyłowymi do ośmiu warsztatów produkcyjnych. Produkcja zasilana parą trwała do 2001 r., kiedy Black Gunpowder Circuit wszedł w skład Seixal Municipal Ecomuseum pod zarządem gminy Seixal. Miało to na celu zachowanie dziedzictwa technicznego, w tym budynków, maszyn produkcyjnych, wyposażenia i narzędzi dawnej fabryki. Co ważne, zakład został zachowany na miejscu wraz z działającą maszyną parową obsługiwaną przy wykorzystaniu wiedzy fachowej pracowników fabryki. Wymagało to wielu procedur technicznych, administracyjnych i zarządzania dziedzictwem, w tym klasyfikacji dziedzictwa, zezwoleń dotyczących urządzeń ciśnieniowych i urządzeń przemysłowych (odnowienie licencji na takie urządzenia uzgodnione z odpowiednimi organami administracji publicznej i gospodarki). W celu realizacji projektu rozwijano również partnerstwo z uniwersytetami i badaczami, w tym w ramach projektu IH4Future – Kultura materialna, kultura naukowa: dziedzictwo przemysłowe w przyszłości, w którego ramach specjaliści: historycy, muzealnicy, i konserwatorzy zbadali materialne zasoby dziedzictwa na terenie byłej fabryki, stosując wiele technik analitycznych. Badania te dostarczyły wiedzy na temat historii przemysłu i rozwoju technologicznego fabryki prochu Vale de Milhaços, która to wspiera jej konserwację i rozwój jako muzeum.

Słowa kluczowe: Vale de Milhaços, fabryka prochu, dziedzictwo przemysłowe, produkcja pary, silnik parowy, konserwacja operacyjna