The International Journal of
TRANSPORT & LOGISTICS
Medzinárodný časopis
DOPRAVA A LOGISTIKA

ISSN 1451-107X

1834 TO 2009 – LOOKING BACK AT 175 YEARS OF WIRE ROPE PRODUCTION AND USE IN THE MINING INDUSTRY

***Rainer Dill*[1]**

Key words: wire rope production, wire rope, mining industry

Abstract:
The paper presents the problem of development and expansion of steel ropes using and conditions of their application in Bergbau.

1. Introduction

Wire ropes as we know them today have a long history. There is already a wide range of publications available on the various aspects and epochs of the history of wire rope manufacturing. In addition to presenting an outline of the development of wire rope production, the present article will focus on the early years of wire rope history, starting with its invention 175 years ago by mining engineer Wilhelm Albert.

2. Background

The invention of wire rope by mining engineer Wilhelm Albert coincides with the period of the industrial revolution in the 19th century. Older literary sources describe the use of hemp ropes a number of millennia ago. Ropes made of metal wires seem not to have come into use until the middle of the last millennium, more specifically around 1500. Overall development and the individual inventions along the way are well described in the pertinent literature; this article will therefore not go into these in any particular detail.

3. Wilhelm Albert

Wilhelm August Julius Albert – who was he exactly? Born on 24 January 1787 as son of the burgomaster of the royal residence town of Hanover, Wilhelm Albert experienced a carefree childhood spent in his mother's care. An excellent and hard-working student, he was well-liked by his schoolmates for his openness, his even temperament and his resourcefulness. Encouraged by his father's interest in music, the young Wilhelm showed early talent as a musician, and at the age of eleven he gave masterly cello and flute performances at the Hanoverian court. Against his parents' wishes, however, he chose to study jurisprudence rather than to pursue a musical career; in 1803, barely seventeen years old, he embarked on the study of law at Göttingen university.

During this time he often visited relatives in the nearby Harz mountains, and he gradually developed an interest for the Harz mining industry. Mining eventually fascinated him to such an extent that he gave up his "dry" legal studies to concentrate on mine engineering. In 1809, at the youthful age of 23, Albert passed his final examinations and took up his first position as auditor in the Hanoverian mining and forestry service. He worked his way upwards in various departments of the service until, on 25 March 1817, he was appointed royal advisor for mining, or "Bergrat", in the Hanoverian administration.

[1] **Rainer Dill**, TSU e.V. , Martinstr. 13, 064 06 Bernburg, Germany, e-mail: dillbbg@t-online.de

3.1. Albert's early days in the mining industry

By now Albert had connection to several mining sites in the Harz mountains, and he was very soon able to identify the main problems facing the industry at this time. With mining pits becoming deeper and deeper, ore extraction was an increasingly complicated and expensive process. The chains used in the shafts, which miners in those days also referred to as ropes, were subject to frequent breakages, so that several pits even returned to the use of hemp ropes.

Wilhelm Albert focused his initial attention on the factors responsible for these breakages. Often enough he was contradicted by opinions and hypotheses expressed by other experts, and he increasingly doubted that these other assumptions were correct. Over time he was able to convincingly present and prove his own views with the results of practical experiments. Chain breakages in mines, he discovered, were neither caused by the chemical effects of water seeping into the pits, nor by excessive test loading or jerking stress in the course of the mining process. Albert demonstrated that in addition to tensile load on the individual chain links, it was bending stress in the traction sheaves that caused the breakages. In early 1829, he built a special chain-testing device to prove his hypothesis – thereby in fact creating the very first fatigue-testing machine! Initially he applied the results of his tests to the development of new chain forms. It was not until after 1830 that he realised that chains (which in his days were still generally referred to as ropes) were in fact not the be-all and the end-all for applications in ore mining shafts.
Around this time, he began experiments involving cables made with test pieces of drawn iron wire. At this point we need to mention the name of a man who was the first to manufacture iron wire in serviceable quality: Ludwig Mühlenpfordt. Mühlenpfordt was director of machinery at the Königshütte iron works in Lauterberg, which also made iron wires. He noticed that existing production technology using wire-drawing pliers invariably led to mechanical changes in the surface finish of the wires. He commissioned a craftsman named Mummenthey with the task of developing a new technological process for the whole of the Königshütte wire production. In addition to new buildings, the changes involved designing new machines and devices, for instance wire production equipment. In September 1833, Mummenthey started working on a coiling drum for continuous wire drawing. After many trials he succeeded, and the Königshütte iron works invited Bergrat Albert to a demonstration of its new wire-drawing technology. Albert was so impressed by what he saw that he immediately ordered wire samples for his experimental work on wire ropes.

3.2. How the first wire rope was made

The mining archives of the German state of Lower Saxony include a file containing all of Wilhelm Albert's drawings from this period. Starting in January 1834, Albert recorded every individual step, every thought, every conversation and especially every one of his experiments, including those that ended in setbacks, in meticulous notes and records. The records show that Albert produced his first test pieces – ropes made of four thin strands and twisted by hand – in his own office. He then subjected these samples to tensile rupture tests using strong horses, and found that all of his samples withstood the tests. Suspecting that he was on the right path, Albert improved his laying technique and at the same time solved the problem of wire joints within the cable strands. Further trials confirmed his ideas and ultimately led to a tangible outcome: in May 1834, he began manufacturing the wire rope required for the Caroline pit near Clausthal in production premises located on the upper floor of the Dorothea pit ore washing plant, a building that was roughly 40 metres long.

Albert had ordered the 3.5 mm wires needed for his project from the Königshütte wire-drawing plant, and they were supplied in lengths ranging from 17 to 38 metres. No greater wire lengths would have been possible with the technology of the day, nor, to use a modern word, under existing logistic conditions. Albert wanted to produce a rope made of three four-wire strands in Lang's lay, but because of the shortness of the wires, he also had to deal with the issue of frequent wire joints. Once again, he solved this problem after numerous experiments in the course of which he also figured out how to create the necessary tools.

For the production of the wire strands, Albert had had the Königshütte iron works manufacture a so-called key as well as a variety of other tools and devices. The strand key had four outside holes and a central hole, the outside holes being connected to the central hole by diagonal slits. By removing one of the locking pins in the connecting slits, it was then possible to take a wire from an outside hole and lay it in the middle hole and to shift a wire from the middle into the now free outside hole. Albert had thus solved the wire joint problem that resulted from the short wires he was forced to use, and here again he was able to confirm his success in countless trials: after roughly one metre, a wire "swap" within a strand, because of the internal friction, could be considered capable of bearing a full load! He then manufactured the roughly 600 metres of rope that were needed for the Caroline pit, producing a rope that had some 300 wire joints! Wilhelm Albert's invention is thus the predecessor of modern splicing techniques.

Once again, it was after long series of trials that Albert found the solution for these wire joints, one that did not require heat treatment of any sort and was therefore not affected by any loss of strength. To cut down the friction in his rope, he used Lang's lay right from the start: first when making the individual strands, and then in the ropes themselves. This type of strand and rope twisting, which was indeed formerly known as Albert's lay, produces a rope that is fully torsion-free. Another advantage of this system is that all the wires are always at the surface of the rope and can therefore be easily inspected. For Albert this was a particularly important point. As we have presented it, Wilhelm Albert's rope-making method all the way to his finished rope shows that he had followed a fully new and original path and that none of the earlier types of ropes can be compared to his new product. This also shows that he had no knowledge of earlier developments.

3.3. The first wire rope

Measuring roughly 600 metres, the first wire rope was surprisingly long, and it proved to be eminently suited for the job at the Caroline pit. In the following two years, Albert produced similar ropes for thirteen other mines in the Harz. His invention was therefore a highly significant one. It must be noted, however, that Albert did not take out a patent for it, as there was no patent system in Germany in those days. But he was happy to share his findings and his experience with colleagues and the general public in articles and lectures. He was often consulted by mining engineers and other industrialists who wanted to know more about his invention. His technical genius and his willingness to share his knowledge earned him a high measure of respect.

The first of Albert's wire ropes was installed on 22 July 1834, the second one day later in the 484 m deep sloping shaft of the Caroline pit. Albert himself stood at the pit side to inspect the ropes, every day at first, then gradually less as they continued to be put to successful use. A number of incidents occurred in the shaft around this time, for instance crashes of hauling skips. Fortunately, none of these had any effect on the ropes, a positive result that set the foundation stone for the triumphant development of wire rope technology! By 1838, eighteen wire ropes had been manufactured and installed in the Harz region alone.

3.4. The triumphal advance of wire rope technology

At the beginning of this article, we read that Wilhelm Albert's pioneering work should be viewed within the context of the industrial revolution. If we compare his work to developments in other technological sectors, we see that rope-making developed at an astounding pace in the years following the production of the first ropes. The first wire rope to be used in the Ruhr valley area was installed on 15 October 1835 by the Essen rope-maker Erckener at the Sälzer & Neuack mine.

The same year witnessed the first shipments of wire ropes to Freiberg in Saxony, and one year later to Przibram in Bohemia. In 1835, a Saxon mine ordered a wire rope from Albert that was delivered and tested in the same year. In 1837 the first ropes were supplied to the copper mining area near Eisleben, and more ropes to the Saxon collieries. At about this time, producers in Saxony also began making their own ropes. More and more wire ropes were also being supplied to mines in the Essen-Werden mining area, and to the Dortmund mining authority. The use of wire rope spread rapidly in the Ruhr. Here and elsewhere, many rope factories that had been manufacturing hemp ropes now switched to wire roping. In England, Albert's wire ropes were used in the mining industry starting in 1839. Here too, the popularity of wire ropes spread rapidly, particularly in the mining industry.

Unfortunately, Wilhelm Albert was able to experience only the first few years of the success of his invention. He became gravely ill and died on 4 July 1846.

References:

[1] Dr. Weise: Erfindung und Einführung des Drahtseiles durch Oberbergrat Albert im Jahre 1834 offprint by Deutscher Kaliverein e.V. Berlin, 1933

[2] Prof. Dr.-Ing. Benoit: Zum Gedächtnis an WA Julius Albert und die Erfindung seines Drahtseiles; lecture held on 21 July 1934 in Clausthal-Zellerfeld

[3] Wilhelm Bornhardt: Wilhelm August Julius Albert und die Erfindung der Eisendrahtseile; commemorative publication in Wilhelm Albert's honour, 1934

[4] Dr. Jehmlich: Anwendung und Überwachung von Drahtseilen, Verlag Technik Berlin 1985

[5] Roland Göock: Die grossen Erfindungen Bergbau - Kohle - Erdöl, published in 1991 by Sigtoch Edition

[6] Dipl.-Ing. Verreet: Eine kurze Geschichte des Drahtseiles, published in January 2002 by PR GmbH Aachen

[7] Hans-Heinrich Hillegeist: Die Drahlhütte der Königshütte in Lauterberg - Grundlage für die Drahtseilherstellung; lecture held at a colloquium on 22 July 2009 in Clausthal-Zellerfeld
[8] Wolfgang Lampe: Oberbergrat Alberts Aufzeichnungen aus der heissen Phase seiner Erfindung; lecture held at a colloquium on 22 July 2009 in Clausthal-Zellerfeld
[9] Catalogues from various European wire rope manufacturers
[10] Catalogue of the Nyrosten GmbH company
[11] Catalogue and company brochure of Elaskon GmbH

Recenzia/Review: *Ing. Janka Šaderová, PhD.*