

## THE RESULTS OF RESEARCH INTO THE CHARACTERISTICS OF COLD DRAWN WIRE, SUITABLE FOR THE EMPLOYMENT OF DISABLED PEOPLE IN THE FIELD OF METALLURGICAL SECONDARY

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### Abstract

The paper deals with the current issue of finding a new production program for employing handicapped people in the form of specifically oriented operations in the field of metallurgical production. It presents the opportunity to use the domestic raw material bases and to prepare the possibilities of evaluation of low-carbon cold-drawn wire and drawn wire of non-ferrous metals. At present, the Czech Republic imports a wide range of small products that require a high share of manual work, patience and manufacturing operations that need only a minimal amount of technological machine equipment in the form of tools and products. It is mainly galantry production, a consumer market area oriented to support small-scale production, crafts and family businesses. The paper presents selected knowledge and practical experience in the field of long-term work with handicapped people. At the same time, the research focuses on the ability of handicapped people to adapt to new production and assembly programs, on work with drawn low-carbon wire. The results of the research show the possibility of using low-carbon drawn wire with its properties for work of handicapped people in protected workshops.

**Keywords:** Low-carbon wire, non-ferrous metals, wire products, handicapped persons, protected workshops

### 1. INTRODUCTION

The aim and goal of this paper is to present the results of the research of properties of cold drawn wire suitable for the employment of handicapped persons in the field of metallurgical production. The authors of the research attempted to make a seemingly absurd connection between the outputs and knowledge of material engineering and long-term work in the field of care and work with handicapped persons. The research is based on earlier quantitative research carried out by authors of the article, confirmed assumptions that in protected workshops in the Czech Republic metal material for work with handicapped people is used only to a minimum extent, and, at the same time, the protected workshops in the Czech Republic have an employee potential for small-scale production of wire articles, provided the conditions for a suitable choice of strength and flexibility of the material used are met.

### 2. WORK OF HANDICAPPED PEOPLE IN PROTECTED WORKSHOPS

This chapter deals with the issue of protected workshops in the Czech Republic with regard to the results of the quantitative research carried out by the authors of the article and the interpretations of the results of this research, which was to find out what are the specifics of the work of handicapped persons, what fields are represented in protected workshops in the Czech Republic and what is the representation of metal material amongst materials used to work with in protected workshops in the Czech Republic.

#### 2.1. Protected workshops in the Czech Republic

Employing people with physical handicap is supported by the state in the Czech Republic - an employer who wants to employ handicapped people can do so by setting up a protected workshop. This is authorized by the

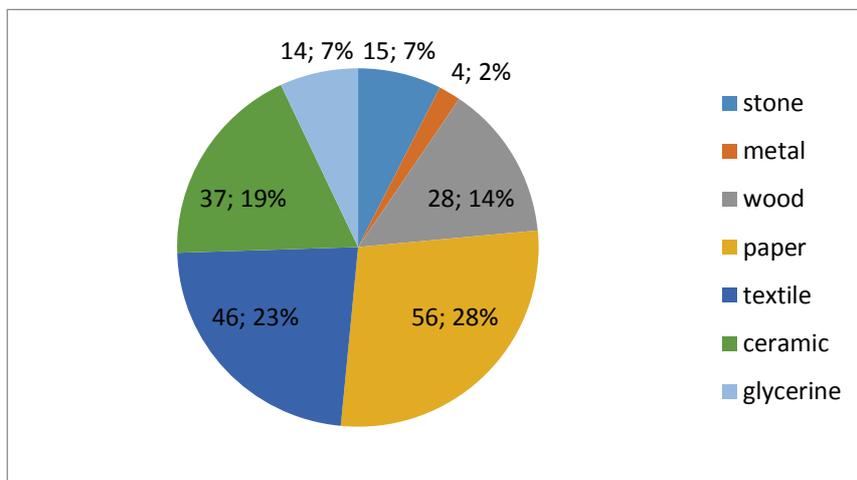
relevant labour offices. The requirement is that the workshop employs more than 60% of people with disabilities and in most cases these workshops associate people who are hard to employ in another workplace. State subsidy is then demonstrated by the fact that the Labour Office generally contributes with financial resources to establishment of such a workshop and, for a certain period of time, it also contributes to the partial reimbursement of operating costs of the same. In addition, it is possible to draw on a contribution for the employment of people with disabilities for the operation of a protected workshop.

**2.2. Representation of metallic materials for work of handicapped people in protected workshops in the Czech Republic**

The authors of this article carried out a quantitative research in 2015-16, which was aimed to find out what works are represented in protected workshops in the Czech Republic, what percentage is represented by metal materials among the materials in general used in protected workshops for the work of handicapped people and what kind of work prevails in these protected workshops, i.e. manual or machine work, for large-scale production or for small or piece job orders. The research was conducted by direct acquisition of relevant primary data using telemarketing. The survey was aimed at respondents that were managers of the existing protected workshops throughout the Czech Republic.

**2.3. Areas of activities in protected workshops in the Czech Republic**

Protected workshops in the Czech Republic deal with the following works: production of detergents, soaps, medical clothing and clothing for food industry, personal protective equipment. They also produce floor rags, towels, dusters. They focus on small-scale finishing, packaging, storage and logistics. They run a workshop with weaving, ceramic and basketry activities. They are engaged in the assembly of semi-finished products and articles made of imitation jewelry, handmade finishing works in the area of cardboard packaging, production of drawn, decorated and perfumed candles and glycerine soaps. They operate assembling and printing workshops, production of musical instruments, wooden toys, interior accessories or artistic objects made of stone, wood and metal, handmade production of notebooks and other paper products, production of small gift and utility items. One of the activities of protected workshops in the Czech Republic is the work with surgical wire. The picture in the **Figure 1** shows this activity which is represented at a minimum extent, in case of 4 of 200 respondents.



**Figure1** Share of metallic materials in protected workshops in the Czech Republic

The very low share of metal products in protected workshops is in particular due to a dramatic change in the branch and industry structure of the Czech Republic industry. Under the pressure of economic and financial instruments, a wide range of final products of secondary metallurgical production from own raw material

resources, in which Czechoslovakia had a long tradition and especially considerable technical and technological know-how, was abandoned.

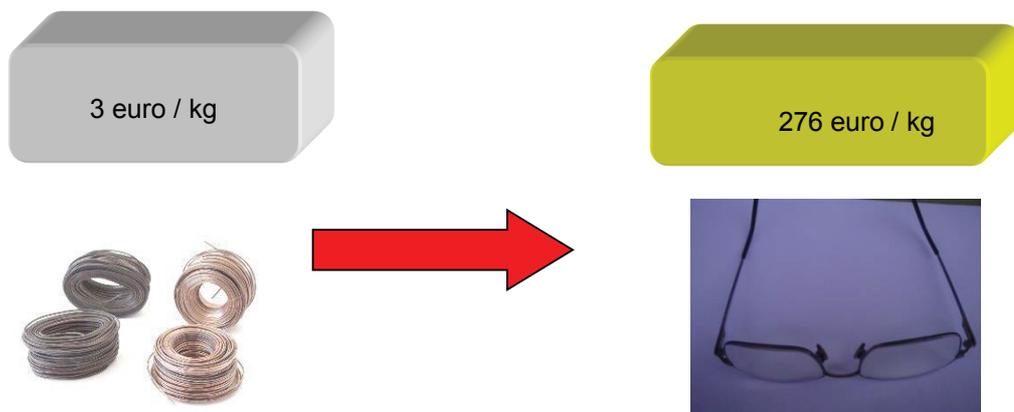
The authors of the article derive from the knowledge acquired about the behaviour of handicapped people in situations when they encounter the need to work, create new values, be useful. It is precisely the need to take paper, wood or metal in hand, to understand their properties, which represents one way to ensure a critical change at the interface between social services and new technologies capable of serving not only the function of usefulness but also the function of a change in the mindset during the phase of consumption of these products.

#### 2.4. Specifics of the working ability of handicapped people

Handicapped individuals with a capacity to work have some specificities in approach to work. They can be very careful and patient, and in the case of mild mental disability they can hold themselves for a long time in the same activity, not to let themselves to be influence by the effects of the environment, which can be useful in works requiring simple manipulation of the material, but with a high level of concentration on the same work. Disabled individuals are able to adapt to the performance of a profession that is seemingly inaccessible to them. A handicapped individual usually has developed compensatory procedures that replace the missing senses or limbs. They can find their own workflow solutions that a healthy individual cannot even imagine. However, the disabled must have an opportunity to adapt to this adaptation [1]. The disabled person should have the opportunity to try out specific activities and find the kind of activity that best suits him or her and to which he or she adapts best [2].

### 3. SELECTION OF SUITABLE MATERIAL FOR PROTECTED WORKSHOPS IN THE CZECH REPUBLIC

For the area of research of a wide range of material engineering, the authors of the research focused on the issue of wire and wire products. This area allows us to explore and develop not only new metallographic features and properties at the interface of ferrous and non-ferrous metals but also the picture in **Figure 2** shows, that it provides a great opportunity to achieve uniqueness in the niche range of products with high added value and usefulness.



**Figure 2** Production with high added value

#### 3.1. Cold drawn wire

We can divide the wire into a drawn steel unpatented (low carbon) wire, a drawn steel patented (high carbon) wire, and a drawn wire made of premium alloy steels. In case of large deformation, the reinforcement is so

high and the deformation of the steel grains is such that the material can no longer be formed without actually breaking it. To restore the deformation capabilities, soft annealing or recrystallizing annealing must therefore be included in the drawing process.

### **3.2. Research - work of handicapped people with cold drawn wire**

Based on research conducted by the authors of this article, low-carbon cold-drawn wire is a suitable material for disabled people in protected workshops. Qualitative research was carried out at ČMELÁČEK z.s. in the presence of specialists in the field.

### **3.3. Research objective**

The aim of the research was to find out, on the basis of the properties of low-carbon drawn wire, its suitability for the work of handicapped persons in sheltered workshops, namely whether they are capable of working with this material and which material properties are the most suitable for this work.

### **3.4. Implementation of research**

For the experiment, 50 adults with disabilities (20 persons with mild mental disabilities, 15 persons with physical disabilities and 15 persons with sensory impairment) were selected and enrolled to the experiment. We have obtained various types and sizes of cold-drawn wire according to the standard: Cold-formed steel wires as well as aluminium and copper wires. We also purchased tools for manual wire processing:

- Wooden or rubber gripper for wire bending and strengthening
- Anvil or steel plate with flat surface for wire straightening
- Clamp for clamping the worked wire and bending or shaping of the wire in jaws
- Pliers with short round jaws for wire bending and forming
- Pliers with flat jaws for bending and forming the wire into sharp bends
- Files with medium and fine structure for working of split ends of wires
- Abrasive screen for wire surface treatment before initiating or before finishing of work with wire

We have created a large barrier-free workshop with individual workplaces and material (cold-drawn low-carbon wire). The participants in the experiment were tasked to perform the specified operation (bending, straightening, cutting, surface treatment, etc.) at different workplaces with different types of wire.

### **3.5. Evaluation of the participants' ability to process low-carbon cold drawn wire**

Two experts for working with wire, two social field specialists, and two senior workshop managers were the evaluators of the research. Each participant was evaluated at each workplace with a score of 1-5, where 5 is the best result. The following criteria were assessed:

- 1) Understanding the assigned task
- 2) Precision
- 3) Speed
- 4) Working with tools
- 5) Procedure

Each participant could obtain a maximum score of 50 at ten locations.

Individual scoring:

- 40 - 50 points: Satisfactory
- 30 - 39 points: Satisfactory with restrictions (under certain conditions)
- 0 - 29 points: Unsatisfactory

Group scoring:

Three groups were scored according to the type of disability. All scores in the group were summed up and divided by the number of group members. The scoring scale is the same as the individual scoring scale.

Overall evaluation:

All participants in the experiment were summed up and divided by the total number of participants. The scoring scale is the same as the individual scoring scale.

The selection of specific technical conditions and research results is also partly influenced by the physical condition of individual workers in protected workshops. This process of processing steel and other wires also requires specific safety conditions and regulations under the given conditions.

#### **4. RESEARCH RESULTS**

Most participants received a Satisfactory scoring, 10 Participants Satisfactory with restrictions and only 4 participants failed (scored unsatisfactory). The group of slightly mentally handicapped people received 38 points, physically handicapped 42 points and those with sensory impairment received 44 points. Overall, the participants received 41 points.

Research shows that, on the basis of its properties, low-carbon drawn wire is suitable for the work of handicapped persons in protected workshops and these people are able to work with this material. Evaluators also assessed which materials are most suitable for the job with regard to their properties.

The most suitable material for handicapped people in protected workshops is the low-carbon cold-drawn wire.

Wires reinforced by drawing - wire for general use, wire for specific use - for nails, bolts, welding wire, concrete reinforcement wire, mattress mesh and upholstery springs, wire fabrics, needles, pins, office and letter pins, clothing hooks, stitching and profile wires - wires of cross sections other than circular: flat stitch wires, split cotter pin wire, wires for sparklers, wavy wires

Annealed wires - wire for general use - wire used wherever its softness, bending resistance is required and its low strength is not a problem, wires for a particular use - wire for mesh and barbed wire, binding wires, for electric wires, for flexible hoses, fabrics, floral wires, sealing wires.

#### **5. CONCLUSION**

The described research is not considered to have been completed. Its aim is to select, on the basis of mechanical values (number of bends and torsions, tensile strength), such wires that are suitable with their deformation resistance especially for manual processing into simple products, using suitable pliers and other working tools. For this purpose, testing machines (breakers, benders, etc.) were not required in the protected workshop conditions. This will be continued in cooperation with some testing laboratories of wire-processing companies. The issue of research of integrity and synergies between different fields of human activity provides the opportunity to create unique and new solutions, new technologies in terms of employment of disabled people in protected workshops. Our research has shown that in real-world practice it is possible to enter into fields that were formerly the exclusive privilege of specialized certified manufacturers. By continuing our research with some testing LABORATORIES OF WIRE-PROCESSING companies, we will bring suggestions for further connections of metallurgy and social area, and we will explore the economic benefits of these solutions.

#### **REFERENCES**

- [1] ŠESTÁK, J. Chráněná dílna - nástroj k pracovnímu uplatnění a začlenění lidí se zdravotním postižením. Týn nad Vltavou: Domov sv. Anežky, o.p.s., 2007. 86 p.

- [2] VAGNEROVA, M. Psychopatologie pro pomáhající profese. Praha: Portál, 2004, pp. 37-45.
- [3] ŠESTÁK, J. Erkenntnis - Unterstützung - möglichkeit: Wirkung und Instrumente des Sozialarbeiters im Integrationsprozess von Menschen mit mentaler Behinderung. Graz: Verein Initiativ für behinderte Kinder und Jugendliche, 2010, pp. 47- 55.
- [4] KORECKÝ, J. Tažený ocelový drát. Jeho výroba a zpracování. Praha: Státní nakladatelství technické literatury, 1954.197 p.
- [5] HELLEBRAND, L. Výroba tvarové oceli a drátu. Praha: Státní nakladatelství technické literatury, 1956. 52 p.