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POSSIBILITIES OF USING RFID TAGS IN LOGISTICS

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Abstract: Systems of automatic identification, which include RFID technology, currently provides an indispensable aid in identifying, recording and tracking of any object. Material of identified object may have a disruptive impact on the functionality of RFID tags - identification labels. To the objects with high permittivity can be mainly included metal objects, and objects with a high content of liquids. Therefore, there is the development of tags that resist these interferences.

1 INTRODUCTION

Informatics and information technologies currently significantly affect all areas of society and thus affect its development. RFID the radio-frequency technology, one of perspective technologies of nowadays, is based on principle of electromagnetic waves extension. It is often mistakenly referred to as the successor to bar codes, but which do not provide the benefits of RFID.

2 INFRASTRUCTURE OF RFID SYSTEM

RFID system consists of three main components:

- RFID Tag - identification label,
- RFID Reader,
- RFID Middleware - reader interface layer.

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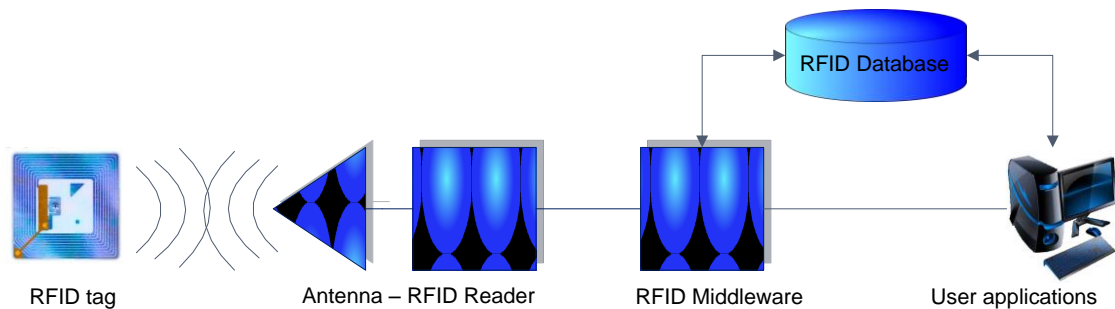


Figure 1 Infrastructure of RFID system (adjusted by [1])

2.1 The principle of operation of RFID

The RFID reader generates a signal through the antenna, which generates an electromagnetic field in its vicinity. If the RFID tag is located in this field, signal from the tag reader antenna is processed to form the oscillating current at a frequency of the transmitted signal. For this reason it is not required to use for passive RFID system (chapter 2.2) any external power supply and no battery power.

The activated tag then sends the programmed information from memory in the form of modulated signal in the space of field. The content of this signal can be, for example, information about how the object was captured (what kind of product from what manufacturer), where and what time was it captured and so on.

The reader detects the modulated signal and sends received data to the middleware. Middleware sends the processed data which are transferred to the bit information to supply or any corporate database system, which they are needed for. [2]

2.2 RFID tags and their classification

In this context, how tags work and what is the energy carrier, RFID systems are divided into:

- **Active** - are composed of active RFID tags. An active tag has a built-in power source (battery), which are powered by electronic circuits. Active tag battery provides several advantages over a passive element, but at the expense of its limited lifetime.
- **Passive** - are composed of passive RFID tags. Passive tag does not require a built-in power supply to operate and the energy derived from radio-frequency signal of reader is used for power.
- **Semipassive** - combines the properties of active and passive tags. Semipassive tags contain a battery which is only used to increase the scan range.

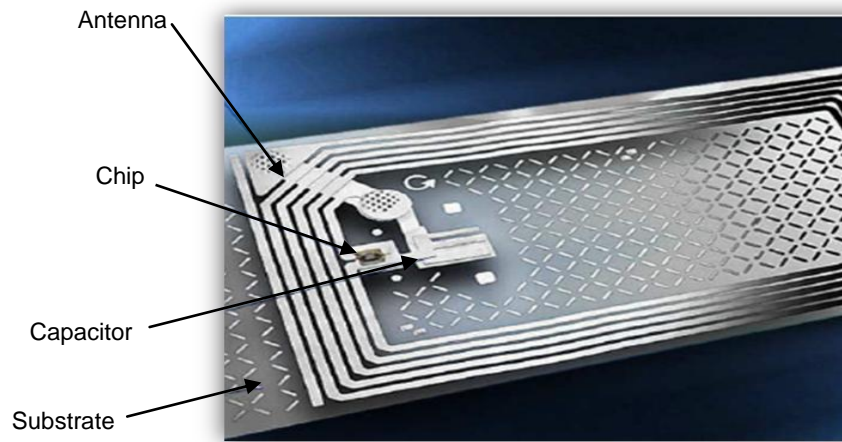


Figure 2 Elements of RFID tag [3]

Another possible classification is a classification of RFID tags by frequency band in which elements of an RFID system communicate.

According to the frequency in which the RFID system works, they can be divided into

- Low-frequency RFID systems,
- High Frequency RFID systems,
- Ultra High Frequency RFID systems,
- Microwaves Frequency RFID systems.

3 IMPACT OF MATERIALS PERMITTIVITY TO RFID TAGS

Radio waves show different properties in different frequencies, so this fact should be taken into consideration when choosing an RFID system. Characteristics, in which the system is generally different in different frequencies, are [4]:

- amount of data transferred per unit of time - the higher the frequency, the greater the amount of decoded data for RF transmission in a shorter time
- permittivity (conductivity) - impact of labeled material on the transmission of radio waves, which may reflect the (multiply), or absorb,
- distance - the maximum shooting distance, the higher the frequency, the greater the impact.

Mentioned "permittivity" is one of the characteristics that influence the location of RFID tags into the environment or the background of high permittivity, in a high rate. Effect of material on tag proves mainly metal objects and objects with high water content. If the UHF (high frequency) RFID tag is placed on an object with a high permittivity, there is detuning the resonance frequency of the antenna and therefore it is impossible for tag to send a response to a signal sent by the reader, i.e. can not be read.

Permittivity is a physical quantity describing the relationship between the intensity of electric field and electric induction in the material or vacuum. Its value depends on the characteristics of the material - i.e. terms of material constants. Permittivity is a dimensionless quantity whose value in the case of materials such as water, ethanol, etc. expresses a single number, for more complex material should be used vector.

Table 1 Permittivity of selected materials [5]

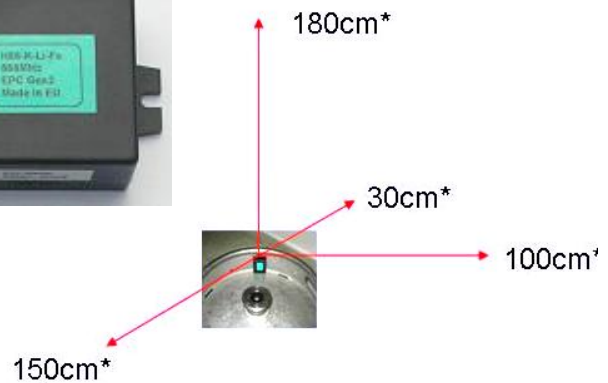
Material	Permittivity (ϵ_r)
Air	1,00054
Polystyrene	2,6
Paper	3,5
Porcelain	6
PVC	3,4 – 4
Glass	7,6
Graphite	12 – 15
Water	81,6

4 APPLICATION OF RFID TAGS IN AREAS WITH HIGH PERMITTIVITY

Given the above, RFID tags are developed to withstand the environment with high permittivity. These are mostly tags on metal objects, with which development deals Ing. Hoffman. [6]

4.1 Development of RFID tags on metal objects

UHF RFID tags on metal – in 2007



UHF RFID tags on metal – in 2009



UHF RFID tags on metal – in 2010

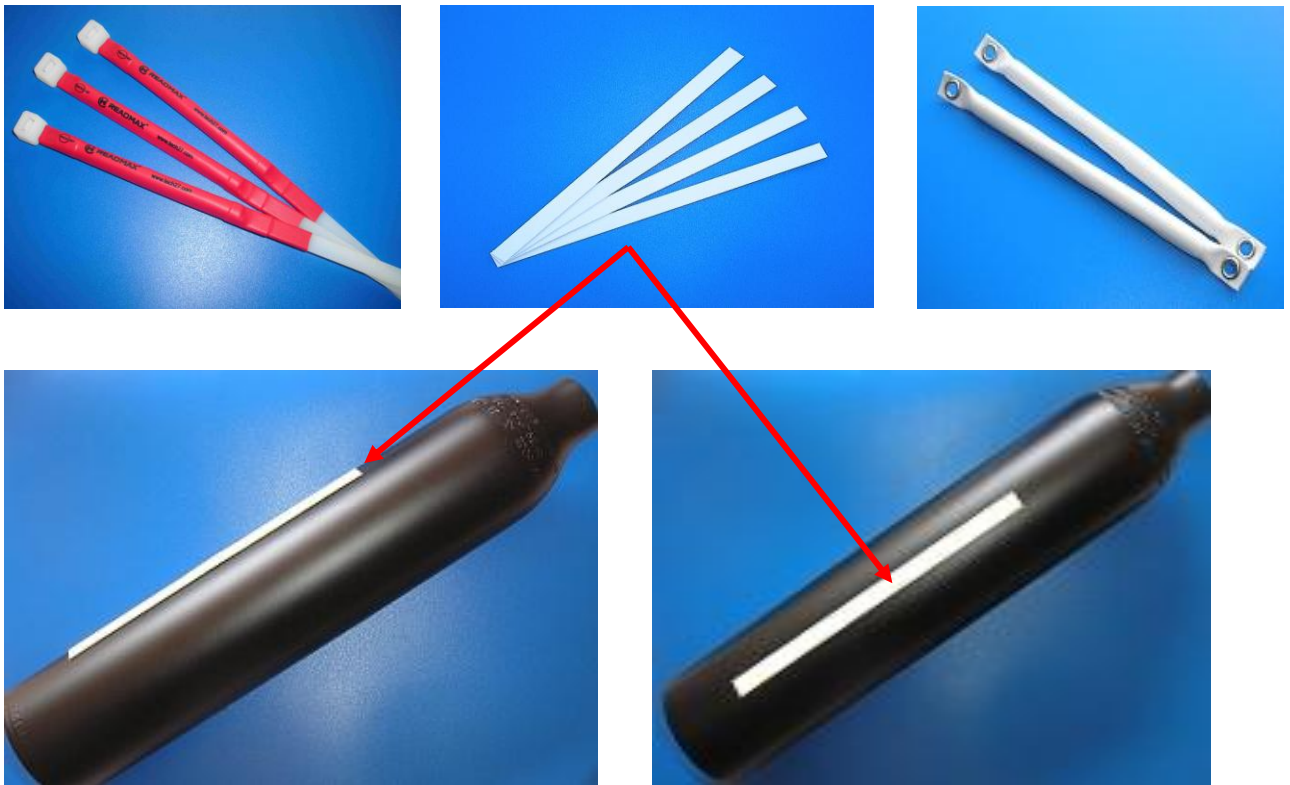


Figure 3 UHF Pulling tape (top left) and RFID label on metal (in the centre)

UHF RFID tags on metal - 2011

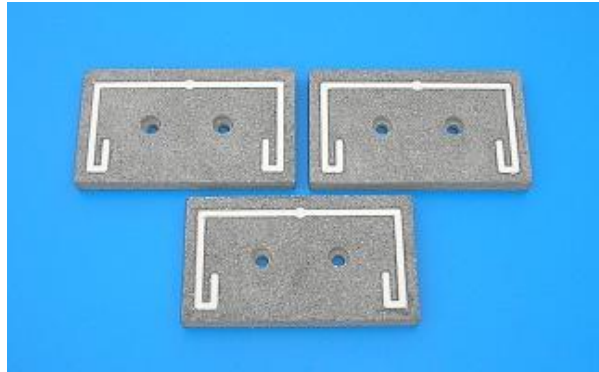


Figure 4 UHF RFID tag on metal (for temperature up to 232°C)

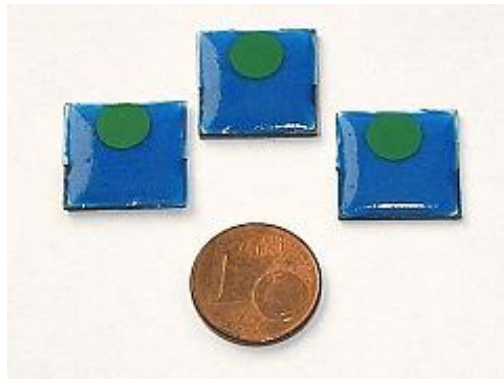


Figure 5 UHF Micro tag on metal 15x15x1,5mm

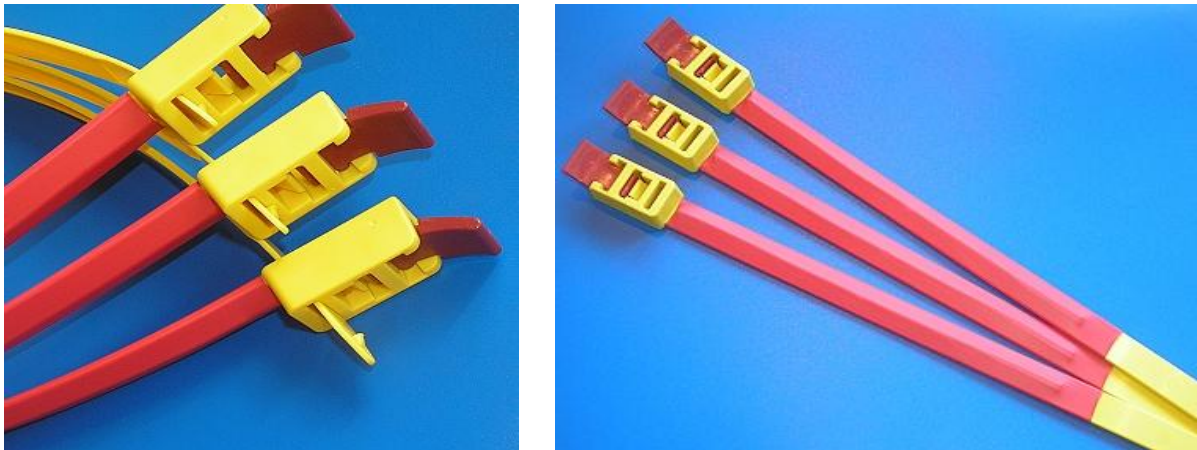


Figure 6 UHF RFID pulling tape to 80 kilograms

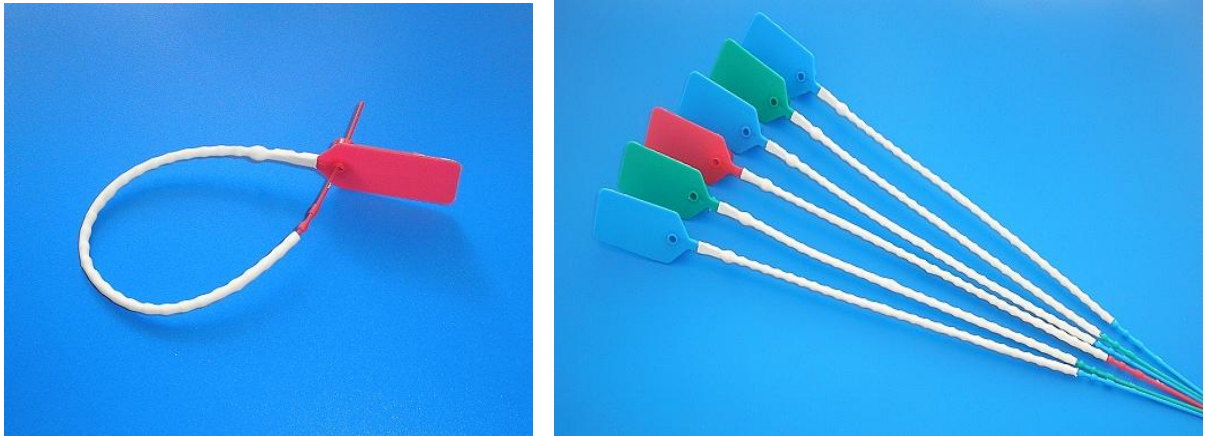


Figure 7 UHF RFID stamp for metal

4.2 Examples of using RFID tags in high permittivity environment



Figure 8 Evidence of measuring instruments (tags on metal 15x15x1,5 mm)



Figure 9 Placing tags on metal drums for a record of production of metal wires



Figure 10 RFID tags (152x8x1 mm STKO Mikulovna) – left, placed on a metal container and the RFID antennas placed on top of the vehicle



Figure 11 UHF passive tag "Cargo" with strong magnets suitable for placement on metal containers



Figure 12 Tag that allows flush mounting to wood, designed for recording the mining in forests



Figure 13 Tags applied in Chemosvit, Inc. for steel press rollers

12 CONCLUSIONS

Basic attributes of all processes in any industry, are the information at the right time and right place. With the support of appropriate automatic identification systems represent an indisputable advantage in logistics, production and trade.

Despite the restrictions, which RFID technology also has, the proof that development don't stagnate are more sophisticated tags with better physical properties, additional functions etc.

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