Tutun/Tobacco, Vol.62, N^{o} 7-12, 109-114, 2012

ISSN 0494-3244

UDC: 628.132:663.97
Original scientific paper

STUDY OF TECHNOLOGICALLY UNUSABLE TOBACCO WASTE AND PRACTICAL SOLUTIONS FOR ITS RECOVERY

Hristo Bozukov, Stefka Kirkova, Penka Zapryanova
Tobacco and Tobacco Products Institute, Plovdiv, Bulgaria

ABSTRACT

Tests of biological waste from the tobacco industry were carried out. The test results led to the following waste recovery solutions. The above 1.00 mm fractions /10% of the sample/ ***can be utilized for producing briquettes.*** The carbon monoxide yield as compared to the cigarette smoke was below the standard limit of 10.00 mg/cig. The above 0.4 mm fractions /90% of the sample/ ***are suitable for nicotine extraction.*** An aggregate /mixed/ sample should be used for nicotine extraction. The tobacco dust /fraction under 0.4 mm/ with high iron content ***is suitable for being used as fertilizer following composting in alkaline soils. All fractions are suitable for nicotine extraction and subsequent composting –*** the fractions contain an optimal amount of nutrients and are low in heavy metal content. ***The material of all fractions can undergo pyrolysis to generate gas.***

Key words: *tobacco, tobacco waste, tobacco waste utilization*

ПРОУЧУВАЊЕ НА ТЕХНОЛОШКИ НЕУПОТРЕБЛИВИОТ ТУТУНСКИ ОТПАД И ПРАКТИЧНИ РЕШЕНИЈА ЗА НЕГОВОТО ОБНОВУВАЊЕ

Извршени се испитувања на биолошки отпад од тутунската индустрија. Резултатите од опитот доведоа до следниве решенија за обновување на отпадот. Горните фракции од 1,00 mm/10% од примерокот/ можат да се искористат за производство на брикети. Количината на јаглерод моноксид во споредба со чадот од цигарите е под стандардната граница од 10,00 mg/cig. Горните фракции од 0,4 mm / 90% од примерокот/ се погодни за екстракција на никотин. Агрегат / мешани / примерок треба да се користи за никотин екстракција. Тутунската прашина /фракцијата под 0,4 mm/ заради високата содржина на железо е погодна да се користи како ѓубре по компостирањето на алкалните почви. Сите фракции се погодни за екстракција на никотинот и последователно компостирање - фракциите содржат оптимална количина на хранливи материи и се со ниска содржина на тешки метали. Материјалот од сите фракции може да се подложи на пиролиза за добивање на гас.

Клучни зборови: тутун, тутунски отпад, искористување на тутунскиот отпад

INTRODUCTION

Currently there are four cigarette factories operating in Sofia, Plovdiv, Blagoevgrad and Stara Zagora, one tobacco processing plant in the village of Yasen and a considerable number of companies involved in tobacco purchasing and preparation. Impurities in the tobacco products are not allowed. Impurities could be organic, inorganic and miscellaneous materials on tobacco leaves and between them [1]. This is why throughout the technological processing of tobacco, it is cleaned and dedusted numerous times. Pneumatic tubes, separation machines and aspiration systems are applied for the purpose. Particles of tobacco origin are being in this way also captured and respectively discarded. This tobacco waste consists of tobacco dust, cigarette machine crumbs, mid-rib and leaf blade pieces, even leaves. Such waste is referred to as "technologically unusable". It is disposed of in regulated waste depots. Its quantity is significant – more than 100 tons per month. It is not being utilized at this point. Moreover, it creates a burden for the processing plants and cigarette factories. There are companies which offer briquetting of waste to reduce the volume and facilitate storage and transport. Even as a waste tobacco is an organic material in which physical, chemical, biochemical and autolytic processes continue to flow. For this reason it heats up and combusts, i.e. the fire risks with tobacco waste storage are significant. On the other hand Bulgaria is legally obliged to comply with environmental requirements in tobacco growing and tobacco products manufacturing [2]. It had been proven that the so called "technologically unusable waste" has ample potential. Biologically active substances and energy could be derived from it and it can be used for fertilizers [3].

The objective of the study was to explore the opportunities for utilizing the biological waste from the tobacco industry.

MATERIAL AND METHODS

We analyzed samples broken down by type of waste and aggregate /mixed/ samples containing different ingredients /dust, crumbs, briquettes, leaf parts, etc./. The tobacco industry biological waste sample underwent fractionation. The fraction analysis aimed at fractionating the sample based on the size of the constituent particles. The fractional composition was established as per BSS 8026-88 using sieves with mesh size of respectively 3.0 mm, 2.0 mm, 1,0 mm and 0.4 mm. In this way we obtained five fractions with the fifth one being in the below 0.4 size range or the so called tobacco dust. Tobacco dust is particles of tobacco ribs and leaf which were sifted through a 0.4 mm sieve. Usually it also contains sand. Sand is composed of inorganic particles stuck on the tobacco leaf or impurities in the dust fraction derived from the tobacco dedusting process. The subsequent tests were carried out by fractions to determine the basic chemical properties of tobacco. The content of the analyzed harmful substances – nicotine, tar and CO – was established by testing lab-manufactured cigarettes. The nicotine content in the extract was analyzed, as well as the content of micro and macro elements. Standardized methodology was applied for the analysis and data processing.

RESULTS AND DISCUSSION

The results of the fractional composition of the aggregate /mixed/ sample are shown in Table 1.

Table 1 Fractional composition

Fraction	Result, %
I fraction - above 3 mm	0.58
II fraction - above 2 mm	2.04
III fraction - above 1 mm	7.13
IV fraction - above 0.4 mm	27.82
V fraction - below 0.4 mm	62.43

The results show the highest percentage was registered in the dust fraction. The lowest was for the particles above 3.0 mm. The sample consisted mainly of particles below 1.0 mm.

Due to the small amount of the I and II fractions, the samples were collected for future studies. Sand was found only in fraction V – 8.52%.

The results are shown in Figure 1.

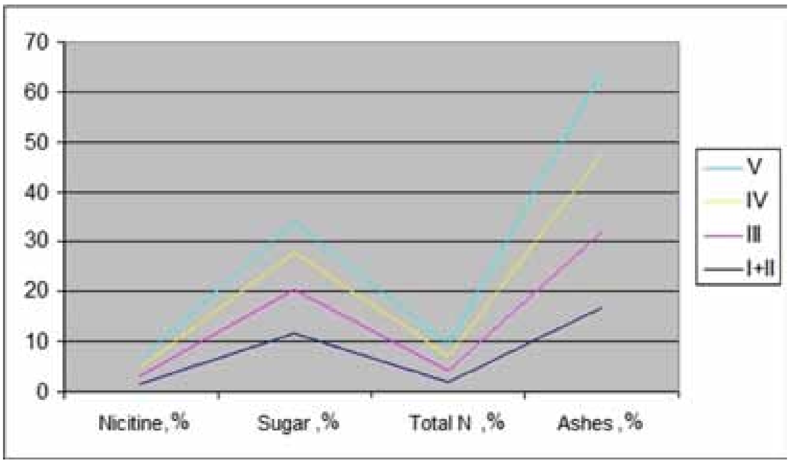

Fig.1 Basic chemical properties of tobacco

It is evident that the first and second fractions contain the highest amounts of carbohydrates. In terms of nicotine and ash contents they are similar to the fifth fraction. The third and fourth fractions exhibit the highest nicotine levels and the lowest ash content. The total nitrogen values are relatively similar.

The test results so far serve for informational purposes and as a basis for outlining further action.

Lab samples of cigarettes containing waste from fractions I, II and III were made for testing the tobacco smoke yields – nicotine, tar and CO, for two reasons:

1. The relatively similar composition of the fractions in terms of the basic properties of tobacco – nicotine, carbohydrates and total nitrogen.

2. The relatively larger size of the particles. It is not possible to make cigarettes using tobacco particles smaller than 1 mm.

Our objective was mainly to establish the carbon monoxide yields.

The tests were carried out on filterless cigarettes with a weight of 0.650 g, paper air permeability – 43.00 CU and cigarette stub length - 23.00 mm.

We assigned arbitrary numbers to the samples, e.g. Sample 1 – fractions I and II together, Sample 2 – fraction III.

The test results are shown in Fig. 2.

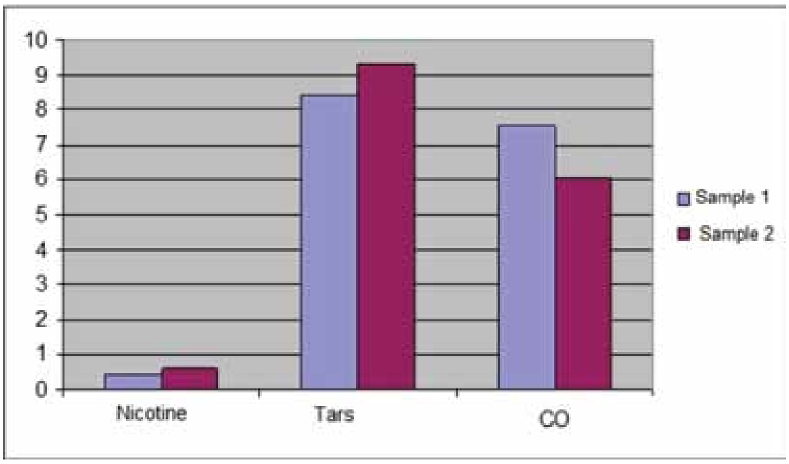

Fig.2 Harmful substance in tobacco smoke, mg/cig

The results are typical and meet the legislative requirements for manufactured cigarettes. Pursuant to TTPA the maximum carbon monoxide yields are 10.00 mg/cig.

Further tests were made to determine the nicotine content in an extract of fraction III /above 1 mm/, fraction IV /above 0,4 mm/ of the aggregate starting sample and separately for briquette, tobacco dust and tobacco leaf and crumb extracts.

The results are shown in Fig. 3.

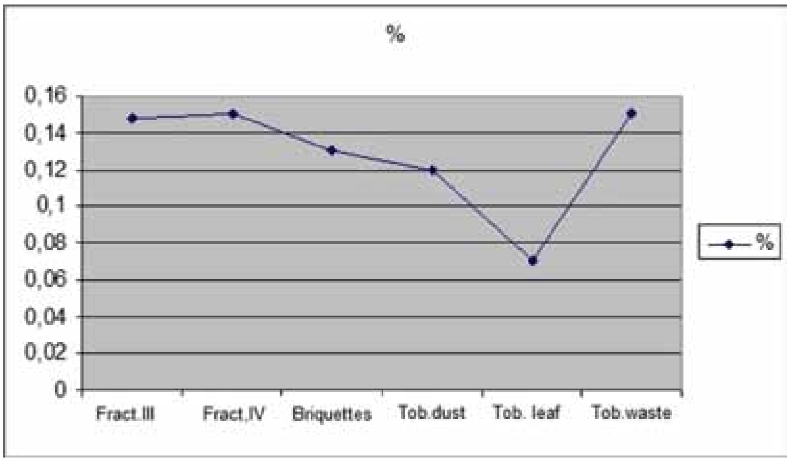

Fig.3 Nicotine content in the extract

The results are indicative of the nicotine variation limits in the extract in the case of separate waste use. The variation is from 0.07 % to 0.15 %. This large value fluctuation does not allow for nicotine extraction from the separate types of waste. In order to retrieve a relatively constant amount of nicotine the biological waste needs to be mixed.

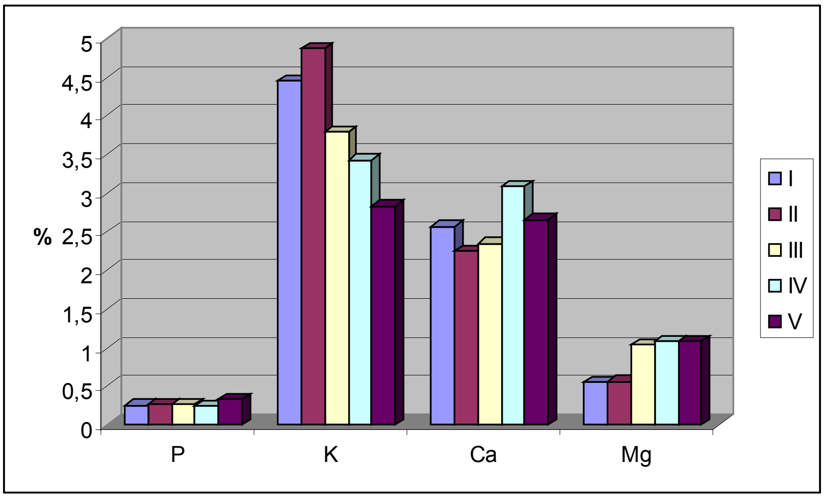

Figure 4. Content of macro-elements in the separate fractions

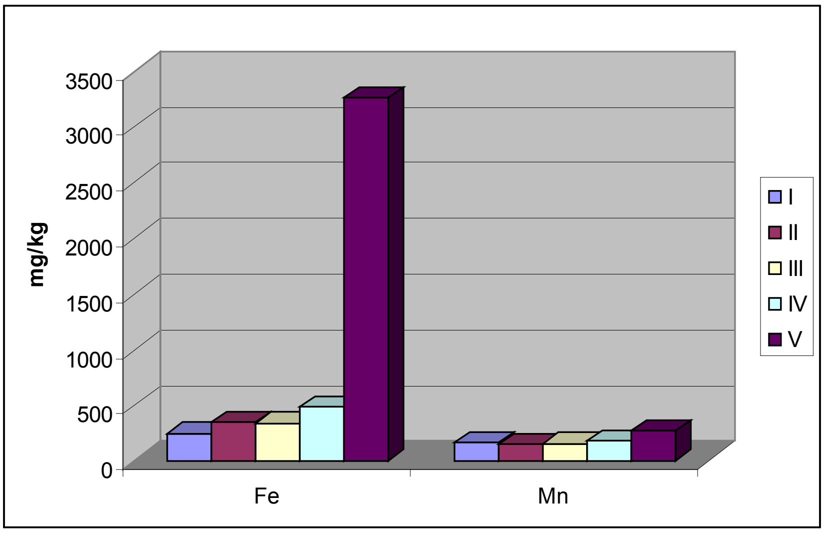

Figure 5. Fe and Mn content in the separate fractions

The nutrients content in the five tested samples was at the normal levels for tobacco and corresponded to the levels cited in the scientific literature (Jones et al., 1991; Drossopoulos, 1992; Campbell, 2000; Zapryanova and Bozhilova, 2009). The iron content registered higher values. According to other publications, the optimal iron content in tobacco leaf is 50 to 300 mg/kg (Campbell, 2000). The iron content found in the four tobacco fractions (from I to IV) is within this range. A concentration of 40-50 mg/kg is deemed to be low (Jones et al., 1991). Data collected by Tso (1990) shows that the iron content in the Virginia tobacco varies from 132 to 595 mg/kg, whereas in the Burley it is 200 to 650 mg/kg. Radojicic et al. (2003) cite levels of 170.72 to 995.87 mg/kg for the Virginia tobacco, Stoilova and Zapryanova (2003) established iron content levels in the Burley tobacco of up to 2257 mg/kg, and Pelivanoska (2007) found iron content levels in the Oriental tobacco from 271 mg/kg to 2532 mg/kg. The iron content in the fifth fraction was 3200 mg/kg.

The heavy metals content in all tested fractions was lower than the critical levels in tobacco (Bozhinova et al., 1995).

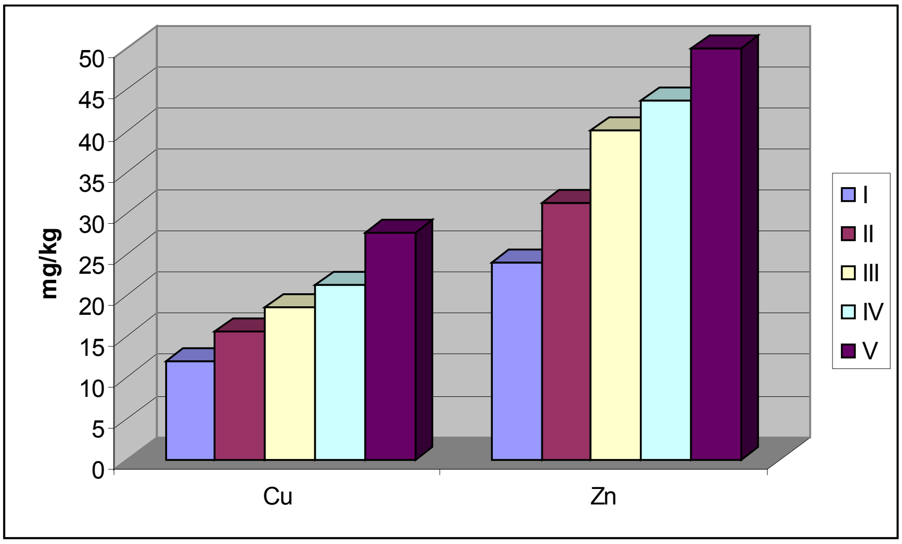

Figure 6. Cu and Zn contents in the separate fractions

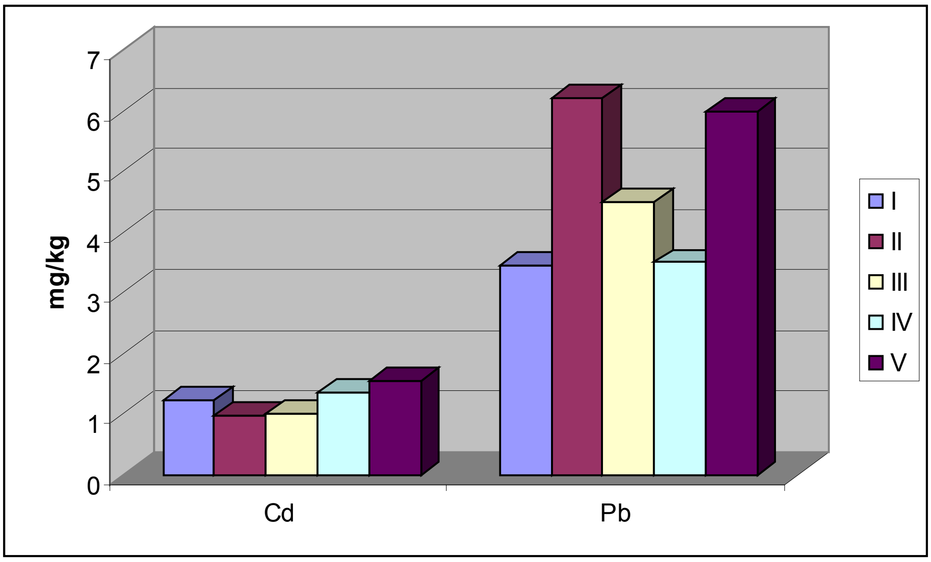

Figure 7. Cd and Pb in the separate fractions

CONCLUSIONS

The test results lead to the following conclusions in terms of utilization of biological waste from tobacco industry.

1. The fractions in the above 1.0 mm range /10 % of the sample/ ***can be used for producing briquettes***. The carbon monoxide emission as compared to the cigarette smoke was below the standard limit of 10.00 mg/cig.

2. The above 0.4 mm fractions /90% of the sample/ ***are suitable for nicotine extraction.*** An aggregate /mixed/ sample should be used for nicotine extraction.

3. The tobacco dust /fraction under 0.4 mm/ with high iron content ***is suitable for being used as a fertilizer following composting in alkaline soils.***

4. ***All fractions are suitable for nicotine extraction and subsequent composting –*** the fractions contain an optimal amount of nutrients and are low in heavy metal content.

5. ***The material of all fractions can undergo pyrolysis to generate gas.***

REFERENCES

1. BSS 8391-85 "Tobacco and Tobacco Products. Terminology":
2. Bozhinova P., H. Chuldjian, V Krastevs, B. Georgiev, 1995. Heavy metal pollution in the region of the Lead and Zink Plant – Kardjali and land use opportunities. SUB, Kurdjali. Scientific conference, 3-10.
3. Bozukov, H. 2012. Tobacco as energy generating plant with high environmental potential. Presentation during the International Business Forum organized by ALDE «New Technologies for Environment Protection», Sofia, Sheraton Hotel.
4. Zapryanova P., R. Bozhinova, 2009. Nutrients content and heavy metal content in the Oriental tobaccos and Virginia tobacco, Ecologia i badeshte , 4, 20-29.
5. Pelivanoska V., 2007. Heavy metal content tests in the tobacco of the Prilep region, Tobacco, 33-41.
6. Framework Convention on Tobacco Control of the World Health Organization, Art. 18 Environment Protection.
7. Stoilova A., P. Zapryanova, 2003. Analyzing the mineral content of Bulgarian tobaccos using Atomic Absorption Spectrometry. Food Technology University _ Plovdiv. Scientific publication, Vol. L, 3, 333-339.
8. Campbell C., 2000. Reference Sufficiency Ranges Field Crops, Tobacco, Flue-cured, www.Ncargr.com/agronomi/saaesd/fluecure.htm.
9. Drossopoulos J. B., A. J. Karamanos, G.G. Kouchaji, 1992. A survey of selected nutrient levels at different leaf position of oriental filed-grown tobacco plants, *Tob. Sci.,* 36, 10-15.
10. Jones J., Benjamin Wolf, Harry A. Mills, 1991. Plant Analysis Handbook, Micro-Macro Publishing Inc..
11. Radojicic V. O., Cvetkovic O., Dukic M., 2003. Uticaj agroekoloskih uslova gajenja na sadrzaj mineralnih materija u duvanu lowera Virdzinija, Tutun/Tobacco,53,3-4,96-104.
12. Tso T. C., 1990. Production, physiology and biochemistry of tobacco plant. Inst. of Int. Development & Ed. in Agr. and L. Sciences, B. Maryland, USA.