International Journal of Innovation and Applied Studies
ISSN 2028-9324 Vol. 12 No. 4 Sep. 2015, pp. 954-960

http://www.ijias.issr-journals.org/

Comparison of Carbon Monoxide Content of various Local, Imported and International Brands of Cigarettes and Cigar Available in Pakistan

Saad Saeed, Sadiq Hussain, Sana Sajjad, Hassan Javed, Omar Shahkar, and Umair Ahmad

Chemical Department, NFC Institute of Engineering and Technology,
Multan, Punjab, Pakistan

ABSTRACT: This work investigates carbon monoxide content of smoke emitted by various local and imported cigarette brands sold in Pakistani markets. Flue gas analyzer IMR 2800-p was used to analyze the smoke by using the bottle method. Nox, Sox and lower explosion limits of smoke was also obtained. The results showed clear distinction between local and imported brands as far as CO content was concerned. Almost all of the local brands exceeded the allowable limit of 20 ppm by a large margin. Cigar was also analyzed and its CO content also exceeded the allowable limit. There is a dire need to investigate these local brands by highly efficient and precise instruments to protect the masses from their harmful effects. Because Pakistan is a poor country, consumers of local brands far outnumber those of imported brands. Cigarette smoking is in itself very harmful but smoking these local brands which don't comply with International Organization for Standardization (ISO) standards for tobacco and tobacco products and regulations can only hasten the journey towards disaster.

KEYWORDS: Cigarette, Carbon monoxide, carboxyhemoglobin, cigar, Pakistan.

1 INTRODUCTION

Modern cigarettes contain tobacco blend, paper, PVA glue to bond the outer layer of paper together, and a cellulose acetate based filter [1]. Tobacco blend gets the most attention as the assembly of cigarettes is not very complicated. The addictive nature of cigarettes is due to the presence of reconstituted tobacco. Stabilization of mouthpiece and moderation of burning of the cigarettes is achieved by Laser drilled air holes [2]. Cigarette smoke contains over 4,700 chemical compounds of which about 60 are carcinogenic. Inhalation of carbon monoxide is the major route of exposure. The major sources of carbon monoxide production are vehicle emissions, cigarette smoke, gas cookers, fires and boilers, paraffin heaters, solid fuel heaters, wood and coal [3]. Exposure to carbon monoxide increases due to incomplete combustion of fuel. Carbon monoxide concentrations in urban traffic have been monitored and recorded [1, 6]. Carbon monoxide concentrations can reach up to 182 mg m-3 (160 ppm) in some homes for prolonged periods. General public rarely comes across such high exposure [4]. Outdoor emissions of carbon monoxide declined by 33 % in the nineties, while emissions from transport declined by 40 % between 1995 and 2005 [5]. In the UK, the Expert Panel on Air Quality Standards (EPAQS) recommended an air quality standard of 10 ppm (8-hour time-weighted average (TWA) [6]. Regular smokers are not affected by normal environmental concentrations of carbon monoxide because their blood levels of carboxyhemoglobin are already higher than would be reached by breathing polluted air [6].

1.1 FORMATION OF CARBOXYHEMOGLOBIN (COHB)

After entering the body through breathing, carbon monoxide binds with the heme component of red blood cells and forms a compound called carboxyhemoglobin (COHb). This affects the capacity of the red blood cells to carry oxygen to the tissues. The tissue of the heart, the brain and the exercising skeletal system have the highest Oxygen demand. Continuous exposure to carbon monoxide increases carboxyhemoglobin concentration until it reaches equilibrium. The increase in carboxyhemoglobin concentration is directly related to persons breathing rate.

Corresponding Author: Saad Saeed

1.2 Effects of Exposure to Carbon Monoxide

Exposure to carbon monoxide initially causes headache, fatigue, dizziness, drowsiness, nausea or tightness in the chest. Prolonged exposure can cause confusion, muscle weakness and collapse. Available evidence suggests that individuals with heart disease, chronic obstructive lung disease, pregnant women, fetuses, and young children represent the population at a greater risk of exposure to carbon monoxide.

2 Cigar

Although cigarette smoking has been slowly declining, total consumption of cigars has increased dramatically since 1993 [7]. Between 2000 and 2012, cigarette consumption reduced by 34.1 percent while cigar consumption increased by 124 percent [8]. Cigars are addictive as well as harmful.

2.1 Health Harms to Users from Cigar Smoking

Cigar smoking is both addictive and harmful. Cigar smoke contains toxic and carcinogenic chemicals that are harmful to both smokers and nonsmokers. Cigars produce more second hand smoke than cigarettes and can contain higher levels of some toxins than cigarettes [9]. Studies have shown that cigar smoke, contrary to popular belief, is inhaled [10]. Cigar smoking is picking up pace and is a modern trend as shown by a recent survey of college students [11]. According to the National Cancer Institute's Monograph No. 9, smoking cigar causes dire health consequences [12].

2.2 Harms from Secondhand Cigar Smoke

Most cigars are larger than cigarettes and therefore, cigar smoke contains substantially higher levels of carbon monoxide and other toxins than cigarette smoke. Second hand cigar smoke is also less filtered than second hand cigarette smoke [13].

3 Experimental

12 different brands of cigarettes (local, imported, international) along with cigar were purchased from the market.

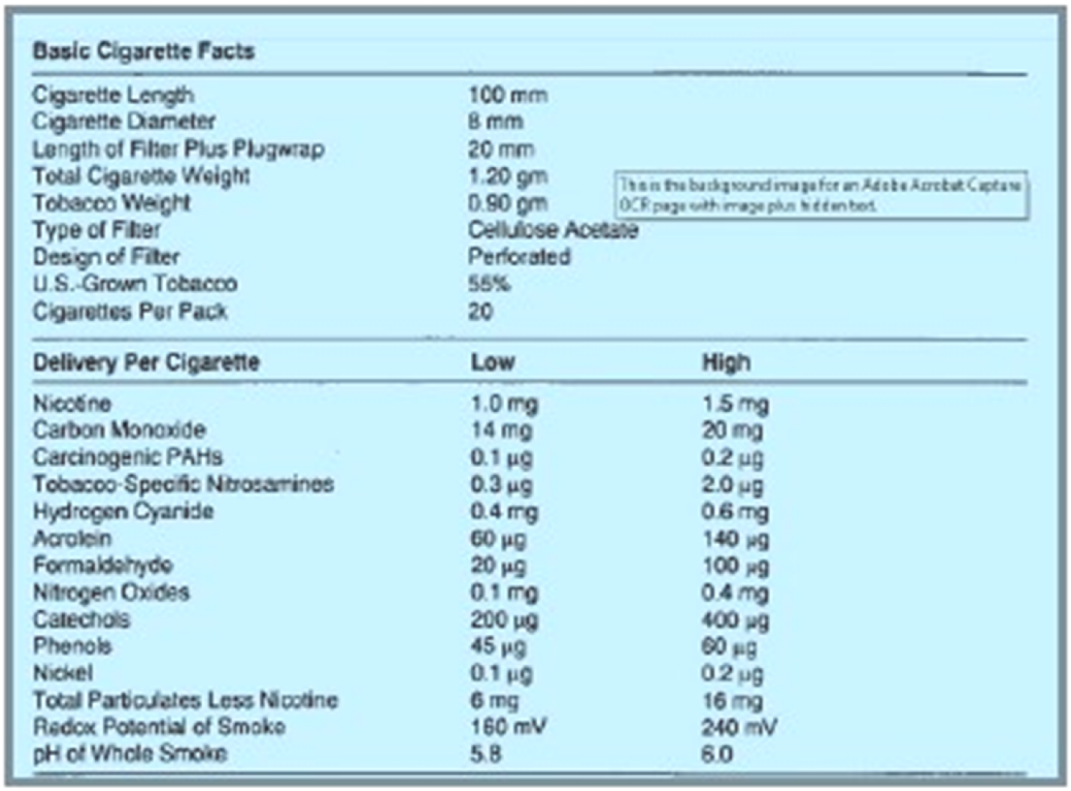
3.1 Equipment: Flue Gas Analyser

Flue Gas Analyzer used to perform the analysis was IMR 2800 combustion gas analyzer available in the Coal/Energy Research Center in NFC Institute of Engineering and Technology.

3.2 Method

Bottle Method

A plastic bottle was cleaned thoroughly with ethanol and then dried and heated in an inert atmosphere to completely remove all the ethanol as well as any trace of moisture. After that, a hole was made at the center of bottle top and another one at the side of the bottle. Hole was large enough to allow a cigarette to pass through. Then the bottle was half filled with tap water. A cigarette was lighted and put in the hole at the bottle top. Smoke was sucked in by the water which was allowed to leave through the opening at the side. After all the water was drained, smoke inside the bottle was puffed out and analyzed with the help of Flue Gas Analyzer. After experiment, bottle was again washed and thoroughly cleaned with the same procedure mentioned above to make sure of the repeatability and reproducibility of the results.



Basic Cigarette Facts

Cigarette Length	100 mm
Cigarette Diameter	8 mm
Length of Filter Plus Plugwrap	20 mm
Total Cigarette Weight	1.20 gm
Tobacco Weight	0.90 gm
Type of Filter	Cellulose Acetate
Design of Filter	Perforated
U.S.-Grown Tobacco	55%
Cigarettes Per Pack	20

Delivery Per Cigarette	Low	High
Nicotine	1.0 mg	1.5 mg
Carbon Monoxide	14 mg	20 mg
Carcinogenic PAHs	0.1 µg	0.2 µg
Tobacco-Specific Nitrosamines	0.3 µg	2.0 µg
Hydrogen Cyanide	0.4 mg	0.6 mg
Acrolein	60 µg	140 µg
Formaldehyde	20 µg	100 µg
Nitrogen Oxides	0.1 mg	0.4 mg
Catechols	200 µg	400 µg
Phenols	45 µg	60 µg
Nickel	0.1 µg	0.2 µg
Total Particulates Less Nicotine	6 mg	16 mg
Redox Potential of Smoke	160 mV	240 mV
pH of Whole Smoke	5.8	6.0

Figure 1 New Cigarette Label Factsheet

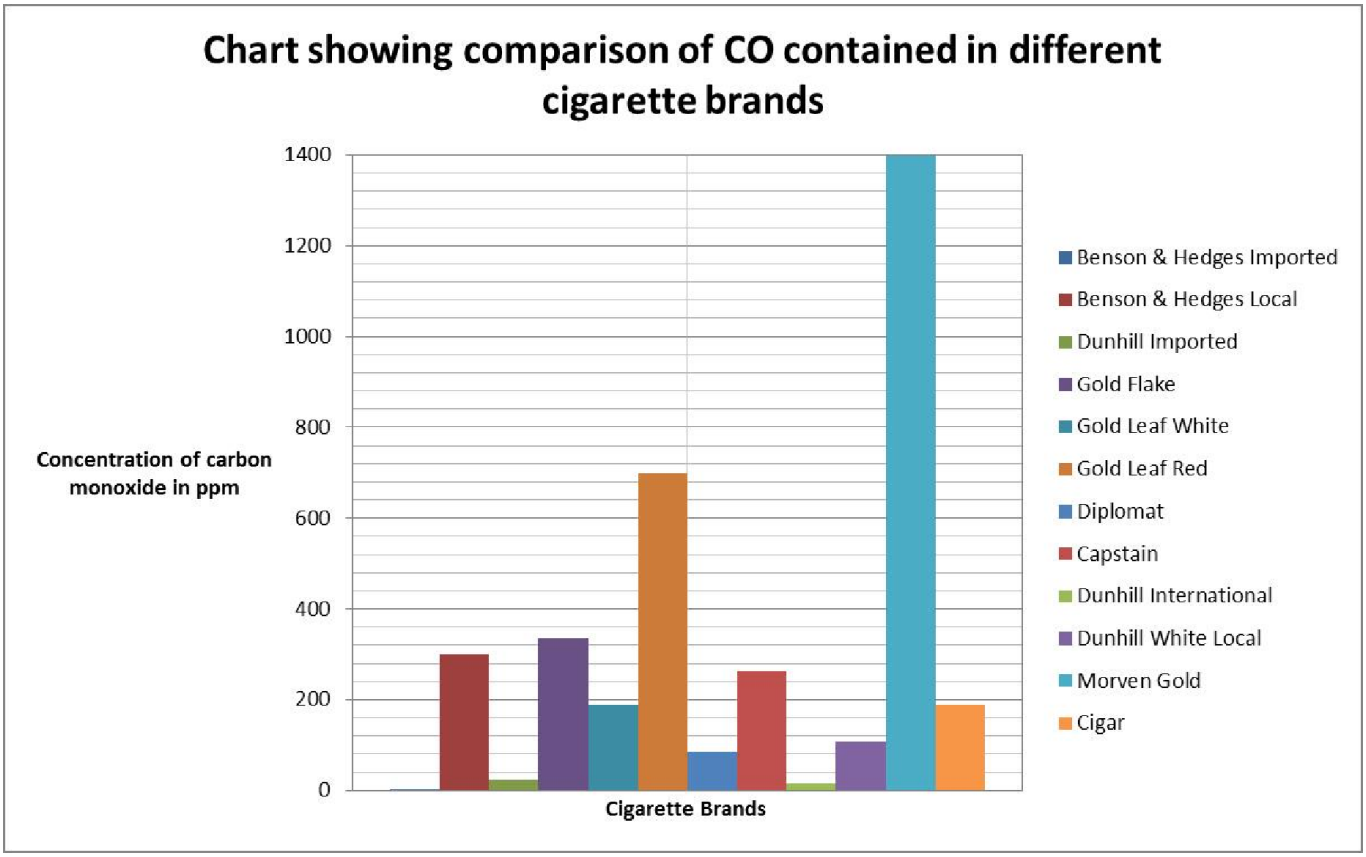


Figure 2 Chart showing comparison of CO found in various cigarette brands in Pakistan

Components	Benson & Hedges Imported	Benson & Hedges Local	Dunhill Imported	Gold Flake	Gold Leaf White	Gold Leaf Red
Unit	ppm	ppm	ppm	ppm	ppm	ppm
CO	4	300	23	336	189	699
NO	0	3	0	3	0	4
NO2	0	0	0	0	0	0
Nox	0	3	0	3	0	4
SO2	0	0	0	0	0	0
Unit	%age	%age	%age	%age	%age	%age
LEL	1.6	4.5	4.7	4.2	0	3.6
CO2	0.2	0.7	0.4	0.1	0	0.4
O2	20.6	19.7	20.2	20.7	20.9	20.3

Figure 3 DATA obtained from FLUE GAS ANALYZER

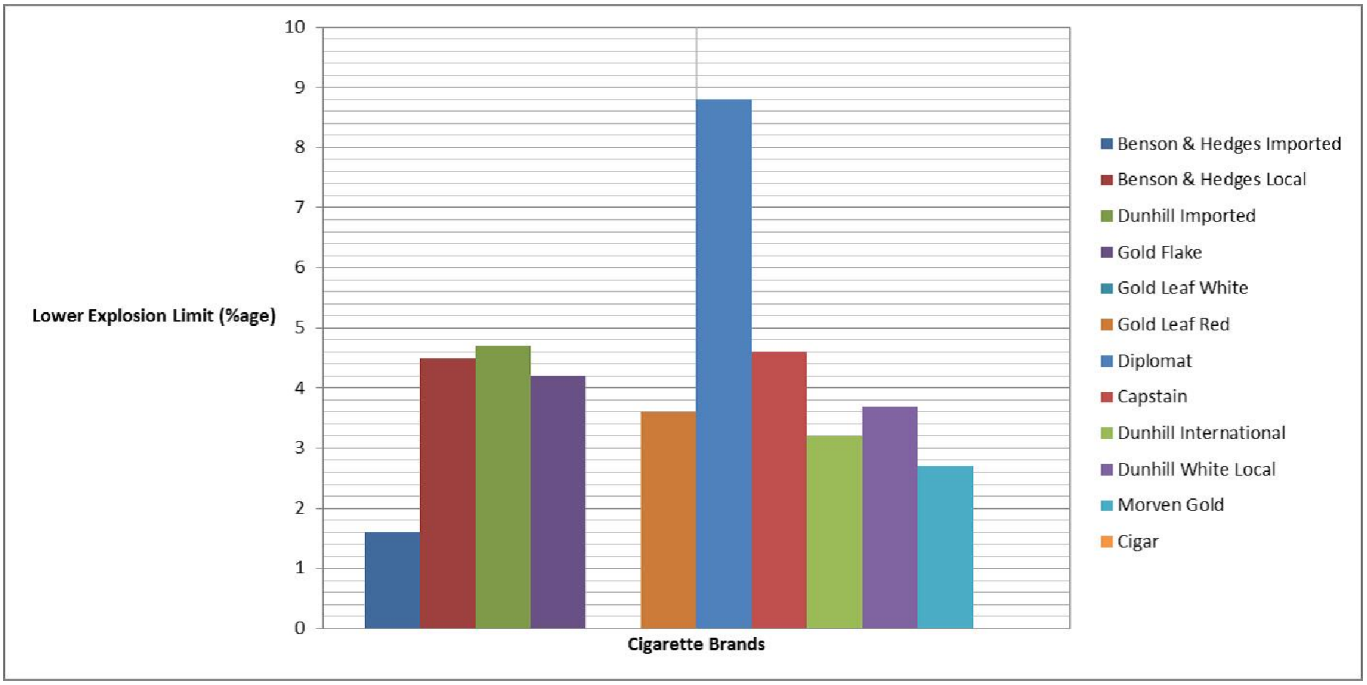


Figure 4 Chart showing comparison of LEL of various cigarette brands in Pakistan

Components	Diplomat	Capstain	Dunhill International	Dunhill White Local	Morven Gold	Cigar
Unit	ppm	ppm	ppm	ppm	ppm	ppm
CO	84	263	16	107	1398	188
NO	0	5	0	0	9	0
NO2	0	0	0	0	0	0
Nox	0	5	0	0	9	0
SO2	0	0	0	0	0	0
Unit	%age	%age	%age	%age	%age	%age
LEL	8.8	4.6	3.2	3.7	2.7	0
CO2	1.1	0.6	0.3	0.5	1.5	0
O2	19	19.9	20.5	20	18.4	20.9

Figure 5 DATA obtained from FLUE GAS ANALYZER

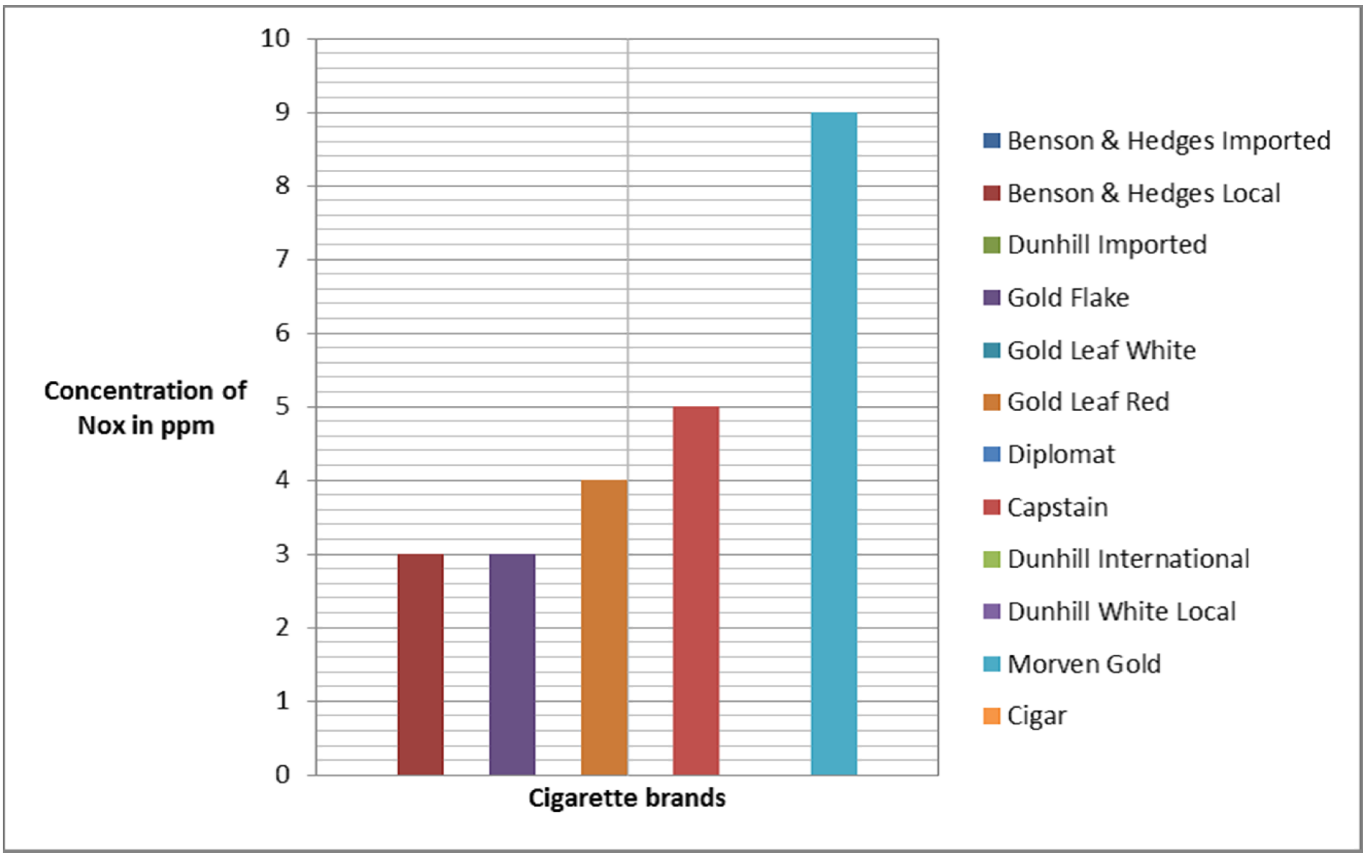


Figure 6 Concentration of NOx emitted by various cigarette brands obtained from Flue Gas Analyser

4 RESULTS & DISCUSSIONS

Figs 3 and 5 show the complete data obtained from Flue Gas Analyzer IMR 2800-p. Let's analyze these results focusing on CO, LEL limits as well as nitric oxide concentrations found in brands analyzed.

4.1 LOWER EXPLOSION LIMIT AND UPPER EXPLOSION LIMIT

Lower Exposive Limit (LEL) for a gas can be defined as the lowest amount necessary to support its combustion in the air. Upper Exposive Limit (UEL) for a gas can be defined as the maximum amount necessary to support its combustion in the air. Flammable range for a gas or a vapor lies between LEL and UEL. A higher value of lower explosion limit is desired as it will mean the cigarette will have a less chance of explosion. Fig 4 shows the Lower Explosion Limit of various cigarette brands. Highest value was observed for Diplomat i.e. 8.8% . Lowest value was observed for Benson and Hedges imported i.e. 1.6% . Equipment was not able to obtain the LEL value of Gold Leaf and Cigar accurately.

4.2 CONCENTRATION OF CARBON MONOXIDE

Fig 2 shows the column chart comparing carbon monoxide concentration in smoke samples obtained from various cigarette brands as well as cigar. It is obvious to see that the three imported brands namely Benson Hedges imported, Dunhill international and Dunhill imported have a low CO content, 4, 23, 16 respectively. Fig 1 shows the acceptable CO content of cigarette smoke as permitted by Food and Drug Administration of U.S.A. The extraordinary high content of CO in nearly all the local brands sold in market is a cause of real concern. The CO content of Morven Gold brand was a whopping 1398 ppm or 2515mg/m3 which is higher than the CO emitted by some 2-stroke and 4-stroke engines of auto vehicles running in Pakistan as reported by a recent study. There was also a huge difference between CO content of local and imported brands of the same company. Cigar also showed a high content of carbon monoxide, i.e. 188 ppm.

4.3 CONCENTRATION OF NOX

Fig 6 shows the column chart comparing NOx concentration in smoke samples obtained from various cigarette brands as well as cigar. Total NOx concentration is due to nitric oxide as nitrogen dioxide was found to be 0 ppm in all the brands analyzed. Only five of the brands investigated showed some value of nitric oxide while others showed a value of 0 ppm. The highest NOx content was 9 ppm, found in Morven Gold.

5 CONCLUSIONS AND RECOMMENDATIONS

We can safely conclude that the local brands of cigarettes available in the market are prepared without keeping in view the International Organization for Standardization (ISO) standards for tobacco and tobacco products placed on them. There is a dire need to investigate these local brands by highly efficient and precise instruments to protect the masses from their harmful effects. Cigarette smoking is in itself very harmful but smoking these local brands which don't comply with the international standards and regulations can only hasten the journey towards disaster. Our research also nullified the perception that cigars are comparatively safer than cigarettes. There is a need to further analyze these local and imported brands for the presence of nicotine, tar, poly aromatic hydrocarbons and other toxic as well as carcinogenic components by new, modern and sophisticated equipment. If they are found to contain high levels of these components exceeding the allowable limits, then strict action should be taken by the concerned authorities against these companies to protect the society from destruction.

REFERENCES

[1] CLEAN VIRGINIA WATERWAYS, CIGARETTE BUTT LITTER - CIGARETTE FILTERS, LONGWOOD UNIVERSITY.
[2] "COMPOSITE LIST OF INGREDIENTS IN NON-TOBACCO MATERIALS".
[3] CHIEF MEDICAL OFFICER (2002). CARBON MONOXIDE: THE FORGOTTEN KILLER.
[4] INSTITUTE FOR ENVIRONMENT AND HEALTH (IEH) (1998). IEH ASSESSMENT ON INDOOR AIR. QUALITY IN THE HOME (2): CARBON MONOXIDE. MEDICAL RESEARCH COUNCIL.
[5] DEPARTMENT FOR ENVIRONMENT FOOD & RURAL AFFAIRS (DEFRA) (2001). AIR QUALITY STRATEGY: PARTICLES, BENZENE, CARBON MONOXIDE AND POLYCYCLIC AROMATIC HYDROCARBONS.
[6] DEPARTMENT OF THE ENVIRONMENT TRANSPORT AND THE REGIONS (1998). CARBON MONOXIDE.
[7] NATIONAL CANCER INSTITUTE (NCI), CIGARS: HEALTH EFFECTS AND TRENDS. SMOKING AND TOBACCO CONTROL MONOGRAPH NO. 9, 1998. ECONOMIC RESEARCH SERVICE, U.S. DEPARTMENT OF AGRICULTURE (USDA). U.S. ALCOHOL AND TOBACCO TAX AND TRADE BUREAU (TTB), TOBACCO STATISTICS.
[8] TTB, TOBACCO STATISTICS.
[9] NATIONAL CANCER INSTITUTE (NCI), CIGARS: HEALTH EFFECTS AND TRENDS, SMOKING AND TOBACCO CONTROL MONOGRAPH NO. 9, 1998.
[10] SEE, E.G., RODRIGUEZ, J, ET AL., "THE ASSOCIATION OF PIPE AND CIGAR USE WITH COTININE LEVELS, LUNG FUNCTION, AND AIRFLOW OBSTRUCTION: A CROSS-SECTIONAL STUDY," ANNALS OF INTERNAL MEDICINE 152:201-210, 2010; MCDONALD, LJ, ET AL, "DEPOSITION OF CIGAR SMOKE PARTICLES IN THE LUNG: EVALUATION WITH VENTILATION SCAN USING 99MTC-LABELED SULFUR COLLOID PARTICLES," JOURNAL OF NUCLEAR MEDICINE 43:1591-1595, 2002.
[11] JOLLY, DH, "EXPLORING THE USE OF LITTLE CIGARS BY STUDENTS AT A HISTORICALLY BLACK UNIVERSITY," PREVENTING CHRONIC DISEASE 5(3):1-9, JULY 2008.
[12] NCI, CIGARS: HEALTH EFFECTS AND TRENDS, 1998. SEE ALSO, BAKER, F, ET AL., "HEALTH RISKS ASSOCIATED WITH CIGAR SMOKING," JOURNAL OF THE AMERICAN MEDICAL ASSOCIATION 284(6):735-740, 2000.
[13] NCI, CIGARS: HEALTH EFFECTS AND TRENDS, 1998 AT CHAPTERS 3 AND 5. RODRIGUEZ, J, ET AL., ANNALS OF INTERNAL MEDICINE 152:201-210, 2010.