

# Comparison of Heavy Metals in Unused and Used Sanitary Napkins of Women

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**Abstract**—For having a hygiene menstrual period, girls in a large number are using sanitary napkins in India because it is easy to use and have better absorbing capacity for menstrual fluid and blood. According to studies in India approximately 335 million women are using sanitary napkins. So to check the effect of sanitary napkins on women, heavy metals such as lead (Pb), cadmium (Cd), chromium (Cr), copper (Cu), nickel (Ni), iron (Fe) and zinc (Zn) are determined in the unused sanitary napkins and these heavy metals was also analyzed in the used sanitary napkins to know the presence of heavy metals in our body. Locally available unused pads and used sanitary pads was collected from Guru Nanak Dev Engineering College for the study. The Atomic Absorption Spectrophotometer is used to check the heavy metal in unused and used sanitary pads. The presence of these heavy metals is found in the unused sanitary napkins except nickel but it is within the permissible limit of heavy metals for human body while the concentration of above-mentioned heavy metals exceeds the permissible levels in used sanitary napkins. Presence of heavy metals in the used sanitary pads is due to the inhalation of these metals through water, air and food that we eat.

## 1. INTRODUCTION

In the older times, during menstruation females use washable and reusable cloth pads but these clothes may cause infection and various kinds of diseases in the females who this type of absorbent. But as the commercial pads came into the market a large number of female group start the use of these commercial pads. But the usage of these pads is increasing day by day, as according to 'Sanitary Protection: Every Women's Health Right', in India out of 335 million women who are menstruating only 12% have access to these sanitary napkins and even the areas where financial conditions are not good the usage of sanitary napkins is increasing.

### Access to Disposable Sanitary Napkin has increased!

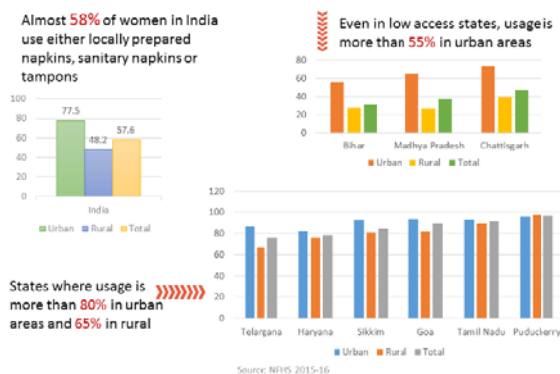


Figure 1: Sanitary Napkin Usage in Rural and Urban Areas in India

Although various other kinds of absorbing products such as tampons, reusable tampons and menstrual cups etc. are used by females in India, but the usage of the sanitary napkins is more than all other absorbing products used by the females.

By seeing this large usage of the sanitary napkins, it becomes necessary to detect the concentration of heavy metals in the sanitary napkins. As heavy metals are the metallic substances which have their density greater than the water. As heavy metals are present in the air that we breathe, water that we drink and food that we eat. And these heavy metals may enter into the human body through various other porous of the skin. The heavy metals are toxic to the human body when these are not metabolized by the human body and find their way to accumulate in soft tissues of the body. However heavy metals are present in the environment and small amount is necessary to be present in our body for having good health, but if these heavy metals are present in the large amount and exceeds the permissible limits than this may cause a serious problem to the human health (Shin et al. 2009). If a person is exposed to the

heavy metals for a long period of time than the person can suffer various problems in kidneys, lungs, composition of blood, liver, central nervous system and may reduce the energy level.

In today's world, most of the studies are done to check the effect of various heavy metals on humans through air, water and soil, but the effect of heavy metals on human body by the use of feminine hygiene products was not checked deeply. So, in the present study the toxicity levels of various heavy metals in unused and used sanitary napkins was evaluated.

## 2. MATERIALS AND METHODS

The various materials and methods used in this study are given below:

### 2.1 Materials

The unused sanitary napkins named 'Whisper Choice Ultra', which are locally available in the market is used for the determination of various heavy metals in the unused sanitary napkins in proposed study. For the determination of the heavy metals in used sanitary napkins, the soiled sanitary napkins of the same brand were collected from Guru Nanak Dev Engineering College, Ludhiana.

#### 2.1.1 Preparation of Ash

The heavy metal content in the unused and used sanitary napkins was detected by converting the napkins into ash. The ash of the unused sanitary napkin was obtained by incinerating the sanitary napkins in muffle furnace and the ash obtained was mixed properly to get a homogeneously sample of ash.

The used sanitary napkin ash was collected from the sanitary napkin incinerator which was installed in the college.

### 2.2 Digestion of Ash Sample

For the digestion of the ash samples of both unused and used sanitary napkins the conventional procedure (EPA Method 3050B) of digestion was used separately for both the samples. According to the procedure 1g ash sample was taken which passed through standard 150 $\mu$ m sieve in a volumetric flask ash shown in figure 2 and a mark of 5ml was mentioned on the flask. Then 10ml solution of 1:1 nitric acid was added into the flask and mixed properly to make a homogenous slurry. After that the sample was placed on the hot plate for heating at a temperature of 95°C for approximately 10-15 minutes as shown in figure 3. Then sample was cooled and more 5ml nitric acid was added into the solution the again heating was done for about 5 minutes and if brown fumes are generated from the sample it means there is oxidation of the sample. Then repeat the addition of 5ml nitric acid into the solution was continued until no any brown fume generated. Sample was cooled and 3ml 30% H<sub>2</sub>O<sub>2</sub> and 2ml of water was added into the solution and heating was done and if bubbles are still there, then add more 1ml of H<sub>2</sub>O<sub>2</sub> into the solution but keep in mind that do not add more than total of 10ml H<sub>2</sub>O in the

solution. After that heating of sample was done at 95°C until the solution volume reduced to 5ml. Now the addition of 10ml of concentrated HCL was done and digestion was done until 5ml solution was left. Then all the sample solution was filtered by using a filter paper of Whatman No. 41 in 100ml volumetric flask as shown in figure 4 and was diluted by using ultrapure water to make a final volume of 100ml for the analysis of heavy metals (cadmium, lead, nickel, chromium, iron, zinc and copper) as shown in figure 5.

### 2.3 Atomic Absorption Spectrophotometer

Heavy metal analysis in unused and used sanitary napkin ash was done by using Atomic Absorption Spectrometer AAS. It works by absorbing light generated by free atoms which occur in vapor state. Then when the sample absorb energy by interpreting spectra in photon light form and then transition of atoms to higher energy levels take place which is known as excitation of sample by radiations.



Figure 2: Ash sample for digestion



Figure 3: Sample for digestion



Figure 4: Sample for filtration



Figure 5: Sample for AAS

## 3. RESULTS AND DISCUSSION

The concentration of various heavy metals in unused and used sanitary napkins is given below:

### 3.1 Heavy Metal Concentration in Unused Sanitary Napkin

The results of various heavy metals such as lead, cadmium, copper, chromium, zinc, nickel and iron are given in the table 1. Results showed the concentration of heavy metals such as lead, nickel, chromium, copper, zinc, cadmium and iron in the

unused sanitary napkins but this concentration of heavy metals did not exceed the permissible limit of heavy metals for human body.

**Table 1. Heavy metals in unused sanitary napkins**

Heavy Metal	Concentration (mg/l)	Permissible Level for human body (Singh et al. 2011) (mg/l)
Lead	0.017	0.1
Chromium	0.030	0.05
Cadmium	0.001	0.06
Copper	0.032	0.1
Zinc	0.046	15
Iron	0.26	0.26-1.7 (for women as per www.medicalnewstoday.com)
Nickel	0	0.0013-0.0033 (Minoia et al. 1994)

Results showed that the concentration of Ni in unused sanitary pad is nil, and after that Fe, Zn, Cd, Cr, Pb, Cu is in the order Ni<Cd<Pb<Cr<Cu<Zn<Fe. From the results it was cleared that this concentration of heavy metals in unused sanitary napkins have no side effect on human body as it falls under the permissible limits of heavy metals in human body [2,13, www.medicalnewstoday.com]

### 3.2 Heavy Metal Concentration in Used Sanitary Napkin

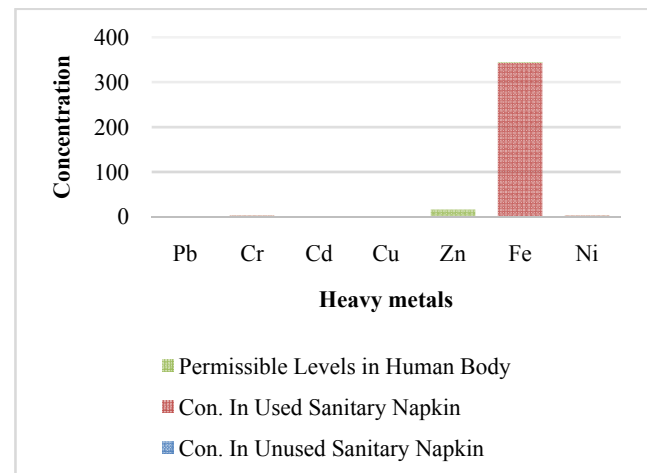
The concentration of various heavy metals in soiled sanitary napkins is given in the table 2. Results showed that the concentration of heavy metals increased in the used sanitary napkins as it was due to the presence of heavy metals (cadmium, lead, chromium) in air that we breathe, water that we drink and food that we eat [10]and due some other anthropogenic activities. Although the cadmium and zinc concentration is increased in used sanitary napkins but it was within the permissible level for human body. The concentration of heavy metals is in the order Cd<Co<Zn<Pb<Cr<Ni<Fe. The concentration of iron in the used sanitary napkins was increased very much as it was 342.95mg/l and is very much high as compared to the concentration in unused sanitary napkins. This increase in concentration of iron was observed because excessive amount of blood flow occur in menstruating females during their periods as its flow is different for different women, iron is the main part of the blood and after incineration of soiled sanitary napkin all other components of sanitary napkin were incinerated but oxides of iron did not burn in the process of incineration and showed their presence in the ash obtained. That was why the concentration of iron was more in the used sanitary napkins as compared to other heavy metals.

**Table 2. Heavy Metals in used sanitary napkins**

Heavy Metal	Concentration (mg/l)	Permissible Level for human body (Singh et al. 2011) (mg/l)
Lead	1.8	0.1
Chromium	2.806	0.05
Cadmium	0.004	0.06
Copper	1.166	0.1
Zinc	1.461	15
Iron	342.95	0.26-1.7 (for women as per www.medicalnewstoday.com)
Nickel	2.893	0.0013-0.0033 (Minoia et al. 1994)

### 3.3 Comparison of Heavy Metals in Unused and Used Sanitary Napkins

As per the results obtained from the analysis of heavy metals in the unused and used sanitary napkins a comparison was made and was given in table 3. The results were expressed in the form of chart and in shown in figure 6 from where it was clearly seen that how much concentration of which heavy metal was present initially in the unused sanitary napkins and what was the increase in the concentration of heavy metals after the use of the sanitary napkins by the menstruating women. The increase in concentration of heavy metals were shown by difference in used and unused sanitary napkins.



**Figure 6: Heavy Metals Comparison**

**Table 3. Comparison of heavy metals**

Heavy Metal	Concentration in Unused Sanitary Napkins (mg/l)	Concentration in Used Sanitary Napkins (mg/l)	Difference
Lead	0.017	1.8	1.783
Chromium	0.030	2.806	2.776
Cadmium	0.001	0.004	0.003
Copper	0.032	1.166	1.134
Zinc	0.046	1.461	1.415
Iron	0.26	342.95	342.679
Nickel	0	2.893	2.893

This was observed from the results obtained that there was a large increase in the concentration of iron in used sanitary napkins i.e. 342.679 and after that chromium and nickel.

#### 4. CONCLUSION

It was observed that the unused sanitary napkins contain the heavy metals in trace amounts but it was within the permissible levels of heavy metals for the human life, so the commercial sanitary napkin have no harm to the human to humans. But the concentration of heavy metals in used sanitary napkins was increased for all above mentioned types of heavy metals except zinc and cadmium. And the concentration of iron, nickel and chromium was more as compared to other heavy metals in the soiled sanitary napkins. This increase in concentration might be due to the inhalation of the various heavy metals from air, water, soil and by coming in contact with the human skin.

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