



## CHARACTERIZATION OF HYBRID BLACK TONER USING THE PARAMETERS WASTE TONER AND NANO PHASE CARBON

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### ABSTRACT

Toner is used in photocopiers to form the latent electrical image on the electrostatically charged drum. The paper picks up the toner particles, when it slides over the drum. Specific factors cause 10% of toner particles (approximately) to be left over the drum. This left out toner is cleaned by the unit to ensure the quality of the proceeding copies. This left out toner is called as waste toner and is collected in cleaner sump. If this waste toner is used in the photocopiers, the quality of the copier is reduced. The waste toner is mixed in proportion with Nano phase Carbon and original toner to get Hybrid Black Toner. The original toner is the toner prescribed for the photocopier by the manufacturer. The hybrid black toner is characterized by the two parameters say waste toner and nano phase carbon in this article.

**Keywords:** original toner, waste toner, nano phase carbon (carbon black nano powder), hybrid black toner.

### INTRODUCTION

Photocopiers are a machine that makes copies of documents. Photocopiers make use of Xerographic technique to print the document. It is a dry process using heat and fuser oil to stick the toner particles onto paper. Copiers also use other technologies such as ink jet, but xerography is standard for office copying.

The inability of the paper to grasp the complete toner particles when it slides over the drum results in sedimentation of toner over the surface of the drum roller. This left over toner known as waste toner is cleaned by the cleaning unit and deposited in the cleaner sump.

Dumping of waste toner in the land causes adverse effects the environment. The waste toner is neither recycled nor reused and it is simply dumped in the landfills. This method of reusing the waste toner reduces the impact of adverse effects made by dumping of waste toner.

### XEROGRAPHY

**Charging:** Cylindrical drum is electro statically charged by a corona wire or a charge roller (high voltage wire). The drum has a coating of a photoconductive material. A photoconductor is a semiconductor material that becomes conductive when exposed to light

**Exposure:** A lamp with high luminescent character illuminates the document, and the white areas of the original document reflect the light onto the surface of the photoconductive drum. The areas of the drum that are exposed to light become conductive. Then it is discharged to ground. The result is a latent electrical image on the surface of the drum.

**Developing:** The toner is made to obtain the positive charge. When it is made to fall on the drum, negatively charged areas in the drum attracts the toner and sticks to the same in micro seconds. This leads to development of image on the drum.

**Transfer:** The resulting toner image on the surface of the drum is transferred from the drum to the paper, when the paper rolls over the drum either from manual feed or automatic or tray feed.

**Fusing:** The toner is melted by fuser and bonded to the paper by heat and pressure from heat rollers, which is nothing but a rubberised hard sheet of drum roller.

### TONER

Toner is a dense, powdery substance with carbon black as its major proportion. The thermal properties of the toner should be soft for the fuser to bind and hard enough so that the toner particles are not fused in the photo receptor at the developmental stage. The rheological properties of the toner must allow coalescence, spreading and finally penetration into the paper for best photo copy. Rheology is the study of flow and deformation of materials under applied forces.

The measurement of rheological properties is applicable to all materials - from fluids such as dilute solutions of polymers and surfactants through to concentrated protein formulations, to semi-solids such as pastes and creams, to molten or solid polymers.

### WASTE TONER

The toner is used in photocopiers to form the latent electrical image on the drum. The paper picks up the



toner particles (image), when it slides over the drum. Nearly 10% of toner particles are left over the drum for a normal document.

The quantity of waste toner produced depends upon the usage of toner and the inability of the paper to grasp complete toner particles from the drum. The waste toner cannot be used for further photocopying, as it does not satisfy the chemical properties and the quality of original toner. The waste toner is hazardous and has to be recycled.

This waste toner is cleaned by the cleaning unit and it is collected in waste toner collector unit or cleaner sump.

### EXISTING SYSTEM

The Hybrid Black Toner is prepared using the original toner, waste toner and Carbon Black Nano powder. The original toner and the waste toner are mixed in the ratio and Carbon Black Nano powder is added to the above mixture.

This composition is made to obtain a homogeneous mixture. The mixture has to be sintered at 413K for about 2 hours obtain the rheological properties back. The original toner is added in proportion to maintain the fusing properties of the hybrid black toner.

### CHARACTERIZATION OF HYBRID BLACK TONER

The Hybrid Black Toner is prepared using the original toner, waste toner and Carbon Black Nano powder. The hybrid black toner is characterised by the waste toner and the nano phase carbon mixed in it. Hybrid Black Toner is characterised by the percentage of original toner present in it with respect to waste toner content.

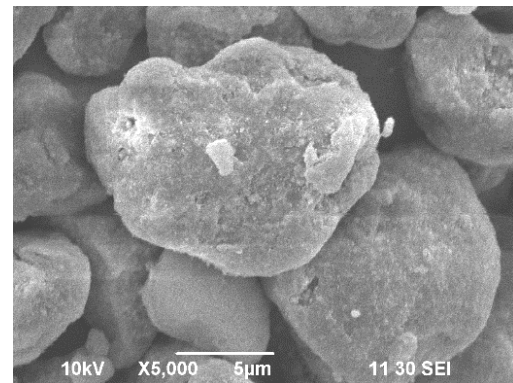
To characterise the HBT, three cases are taken for analysis as shown in Table-1 Composition of Cases under study.

**Table-1.** Composition of cases under study.

S. No.	Compound	Composition		
		Case 1	Case 2	Case 3
1	Original toner	10%	15%	20%
2	Waste toner	90.9%	84.9%	79.9%
3	Carbon Black Nano Powder	0.1%	0.1%	0.1%

### SEM ANALYSIS

Scanning Electron Microscopy also known as SEM analysis is used extensively in micro structure analysis. The signals generated during analysis produce a two dimensional image and reveal information about the sample including external morphology and orientation of the materials making up the model.



**Figure-1.** SEM analysis of waste toner.

Energy Dispersive X-ray Analysis is widely used technique to analyse the chemical composition of a material under SEM. X-ray data is processed to obtain the percentage of each measured element in the individual particles.

**Table-2.** Hybrid black toner - Case 1.

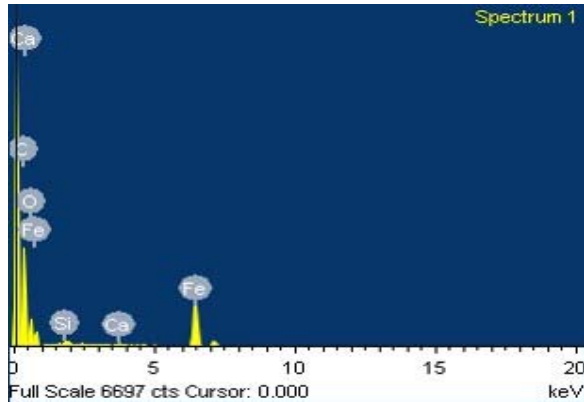
Element	Apprx. conc.	Intensity cornn.	Weight %	Weight % sigma	Atomic %
C K	95.47	0.9286	86.06	0.78	71.92
O K	21.73	0.5159	22.95	0.85	22.17
Si K	00.48	0.8430	00.30	0.09	00.16
Ca K	00.52	1.2031	00.30	0.09	00.15
Fe K	30.50	0.8555	20.34	0.46	05.60
Total			100.00		

**Table-3.** Hybrid black toner - Case 2.

Element	Apprx. Conc.	Intensity Corr.	Weight %	Weight% sigma	Atomic %
<b>C K</b>	95.50	0.9279	86.09	0.78	71.98
<b>O K</b>	21.75	0.5612	22.93	0.83	22.11
<b>Si K</b>	00.49	0.8349	00.32	0.10	00.19
<b>Ca K</b>	00.54	1.0221	00.28	0.09	00.12
<b>Fe K</b>	30.48	0.8154	20.37	0.45	05.60
<b>Total</b>			100.00		

**Table-4.** Hybrid black toner – Case 3.

Element	Apprx. Conc.	Intensity Corr.	Weight %	Weight % sigma	Atomic %
<b>C K</b>	95.52	0.9278	86.10	0.78	72.00
<b>O K</b>	21.73	0.5162	22.92	0.82	22.09
<b>Si K</b>	00.48	0.8439	00.31	0.09	00.17
<b>Ca K</b>	00.53	1.0231	00.25	0.08	00.11
<b>Fe K</b>	30.52	0.8155	20.39	0.48	05.63
<b>Total</b>			100.00		

**Figure-2.** EDAX analysis of Hybrid Black - Case 1.

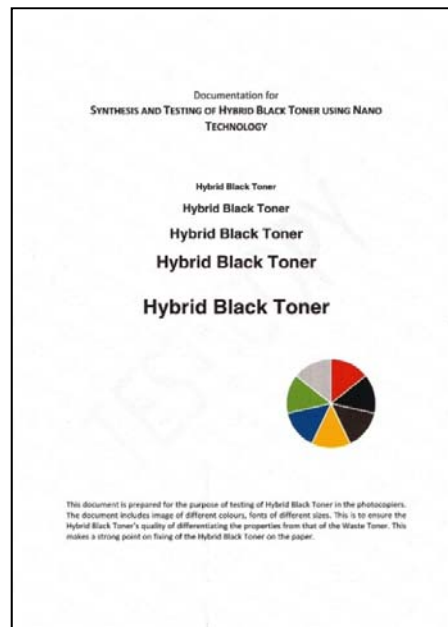
The table specifies the composition and concentration of each element present in the three cases under study @ 0.1% of Carbon Black Nano Powder.

### TEST RESULTS

The Original Test Document is as shown in the Figure-3 and the same is prepared accordingly that may be used to test the specified desirable properties.

Each composition under all the three cases under study is injected into the cartridges separately. Then they are inserted into the photocopier. Photocopies are made using the Original Test Document.

The results are scanned at 400 dpi using Canon Océ Plot Wave 300 and as shown in the Figure-3 and Figure-4.

**Figure-3.** Original document.

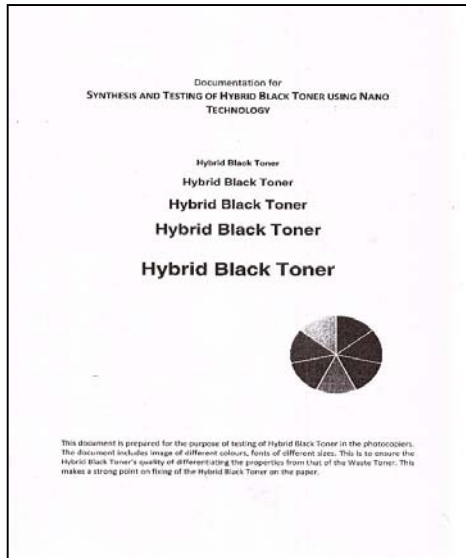


Figure-4. Hybrid black toner Case - 3.

## QUALITY RESULTS

The efficiency curves are drawn with respect to the percentage of nano phase carbon at constant percentage of original toner. The quality test is performed with respect to nano phase carbon content at constant original toner percentage content.

The quality is poor and it is around 10% when Carbon Black Nano Powder is not introduced. The quality increases steadily till 0.1% of Carbon Black Nano Powder and there is no abrupt changes in quality after 0.1% of Carbon Black Nano Powder.

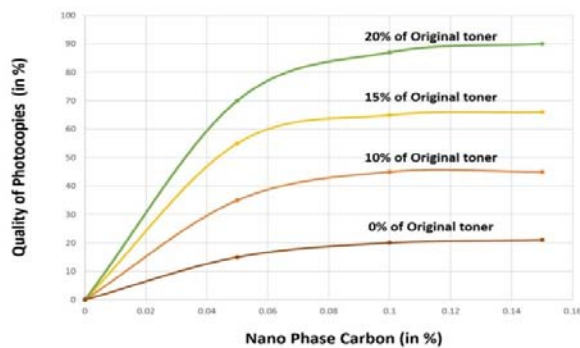


Figure-5. Quality vs nano phase carbon @ constant original toner composition.

## CONCLUSIONS

The characterization chart yields the report that the optimum percentage content of Original toner in Hybrid Black Toner must be 20% to ensure the photo copy quality, rheological properties of the Hybrid Black Toner.

From the Test results, the maximum possible efficiency that can be obtained from HBT is at 20% of Original Toner and 0.1% of Carbon Black Nano Powder.

From the Quality results, the quality is around 90% when HBT composition is 20% of Original Toner and 0.1% of Carbon Black Nano Powder.

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