Presentation of a New Environmental Rating Scale for Evaluating the Sustainability of Digital Printing Systems

Werner Sobotk; VFG (Research Organization for Graphic Arts and Media), Vienna, Austria

Abstract

The paper is dealing with an overall rating system for digital printing systems putting different parameters in consideration.

Different parameters are used to form a sustainability number of 100, which is a system completely sustainable in use.

From 60-100 a system can berated as an environmental friendly ans sustainable system.

Different parameters are rated for the number 100 like deinkability, paper quality (FSC, PEFC, paper profiles) energy consumption, C02 output, VOC figures, toner, inks, used chemicals, ,percentage of waste paper in production, air pollution, archive quality.

All this figures are rated according their importance for the complete environmental process and deinking and paper re more important as energy consumption as an example.

Beside this number 100 there are facts like especially toxic and carcinogenic substance or not deinkable which exclude a system to be rated at all. This list will be added as an addendum to this rating system. Different systems will be rated according our new rating system.

Digital Printing Systems

First of all the printing system has to be clearly defined.

1.1 Electrophotographic system
1.2 Magnetographic system
1.3 Ink Jet

Dry toner technology
Liquid toner
1.2.1 Dry toner
1.3.1 Aqueous based inks
1.3.2 Pigmented inks
1.3.3 Solid inks
1.3.4 Solvent based inks

Materials used

2.1 Toner
2.2 Inks
2.3 Paper
2.4 Other necessary chemicals

Exclusion factors for environmental rating

3.1 Health-, safety- and environmental criteria's
3.2 not good enough deinking
3.3 CO2 emissions to high
3.4 Emission too high

Health-, safety- and environmental criteria's

Overall considerations

This is the main parameter for rating a digital printing system all figures not according the listed regulations are excluding a printing system

Recycling capacity concerning the construction of the digital printing unit

Avoiding fixed connections

Recycled materials should be used in manufacturing whenever feasible.

Mainframes, accessories, and replacement parts should be designed to be remanufactured or recycled.

System modularity can enable upgrades and extend useful life.

Definitions of used plastics especially free of halogen polymers

Using definitions ISO 11469:2000 and ISO 1043 part 1-4

Batteries and accumulators fro heavy metal components like lead, cadmium and mercury

Paper used

The printing system has to able to print on paper produced of 100% recycled pulp and paper FSC or PEFC certified.

OPC drums and ORCs

Must be free of selenium, lead, mercury or cadmium and used one have to be taken back by the producer. Should be recyclable and should be rotated for extended life.

Requirements for toner and inks

Toner and ink modules, cartridges.

The design should be outlined for recycling or reusable.

Important facts: Toner –or ink modules for different colors are separately changeable. Containers for dry ink should be recyclable.

Toner and ink modules are refillable or can be consolidated. Toner- and ink modules are so constructed those other functions like charging, cleaning or print heads – (optional).

Excluding facts for the rating system

Toner or inks must be free of components, which are listed in guideline 67/5487EWG and are rated according appendix VI with R:

R40 (suspicion to create cancer)
R45 (create cancer)
R46 (create mutagen effects)
R49 (crate cancer through breathing)
R60 (can effect reproduction)
R61 (can effect pregnancy)

R62 (can effect the child during motherhood)
R68 (irreversible damage)
AMES- test has to be negative
Toner or ink must be deinkable (see deinking)
Free of mercury, lead, cadmium- or chrome VI- components
Free of azoic-dyes and pigments which can set free amines list of the chemical substances are listed in guideline 2002/61 EC (or TRGS 614)
Special user manual for toner and inks has to be included.
Biocides in inks have to fulfill the requirements of EC guideline 1048/2205

Emissions

TVOC (Total Volatile Organic Compounds)
Single component evaluation for: benzene, polystyrene, ozone
and dust

Methods:

Method for emissions from digital printers RAL-ZU62, 85 and 114 or www.blauer-engel.de
ECMA-standard 328 Detection and measurement of chemical emissions from electronic equipment
www.ecma-international.org
DIN-ISO 16000-6: Inside air pollution. Part 6: evaluation of VOC
ISO 554
DIN 33870 edition 2001-01

O.Jann, J.Rockstroh, O.Wilke: Influence of emissions from hardcopy devices to indoor air quality, Proceedings of Indoor Air 2005, Beijing , Vol2. 2123-2128

Limitations for rating:

Emission rates during printing in mg/h

	Color	b/w
TVOC	20	15
Benzene	≤ 0,05	≤ 0,05
Styrene	2,0	1,5
Ozone	3,5	2,0
Dust	4,0	4,0

Energy

The energy consumption should be put in correlation with the speed of the printing unit by production.
The energy consumption has to be individually calculated taking following parameters in consideration:
Energy consumption of the printing unit in standby mode
Energy consumption during printing
Printing speed calculated in A4 equivalent
The calculation should deliver the energy consumption for printing including

Standby energy per A4 sheet should be measured in Watt. Figures will be announced after comparison of different printing systems on the market.
Testing according the energy star program in the US and EC market.
Power necessity for maximum power consumption in Watt about ≤5000 Watt as a basic figure for digital printing units without finishing and surface treatment.

Noise

Measurements according EN ISO 7779:2009 in connection with ISO: 1988

Deinking

Deinking can be measured with INGEDE method 11 maximum deinking points 100
71-100 good deinkability 30 points
51-70 enough deinkability 20 points
0-50 deinking possible 10 points
negative deinking one parameter was not successful

Other possibility 1 t of clear defined paper samples (dry toner, liquid toner, inkjet inks of one provenience like pigmented inks, normal inks, solid inks ans.) have to be deinked in a paper mill and the results have to be documented with paper samples, origin of raw material and used procedure including chemical components of the deinking recipe.
Definitions like INGEDE method listed before.

CO2 emissions

There is urgent need for action, thus the need to reduce the Co2 emissions worldwide. The emissions for every printed digital print can be calculated putting paper, toner, ink, colorants, chemicals and the printing process itself especially drying systems. There are several emission calculators on the market, which assure a fast process and creation the CO2 emissions. As a possibility the emission output can be compensated by the purchase and deletion of ecological highly quality emission reduction certificates from recognized climate protection projects. Therefore the CO2 emission should be listed from the digital engine producer as a technical detail.

Amount of Waste-paper

Reliable paper handling should minimize paper jams down to 1 for 10.00 copies. Color consistency and operator control should reduce unacceptable prints (waste) down to 10 per thousand copies. Monitoring and registration control are factors reducing waste. Large sheet sizes improve print efficiency and reduce paper consumption. Also front-to-back registration systems reduce waste in finishing operations.

Rating system for digital printing systems

Overall Rating factor 100

8.1 Maximum points for deinkability	30
8.2 Maximum points for recycling capacity of construction parts	20
8.3 Energy consumption maximum points	30
8.4 Waste-paper percentage in production	20

8.5 TVOC and emission factors	20
8.6 Toner and ink formulation	20
8.7 Paper usage	20
8.8 Noise rate	10
8.9 CO2 emissions	20

Formula:

Deinking
+ (Recycling capacity x 0,8)
+ Energy rating
+ (Waste paper production x 0,5)
+ TVOC and emission factor
+ (Paper x 0,4)
+ (Noise rate x 0,5)
+ (CO2 emissions x 0,5)
+ Toner and ink formulation

= rating factor

Conclusion

Looking at all publications and standards available worldwide for environmental friendly digital printing systems it was evident that the main criteria's looking at the procedures, the digital printing units, the materials and chemicals necessary for printing and the printed result that following parameters are the most important one:

1. **Deinkability** of the produced prints especially looking in to future production technologies where digital printing is the most growing market especially for photo books, transpromo and newspaper technologies. These products are penetrating the mass market of printed products and therefore it is important that the prints can be deinked properly.
2. **CO2 emissions and energy consumption**.
   The 20%20%20% regulation.
   Reduction of emission about 20%.
   Arising energy efficiency about 20%.
   20% energy from renewable energy resources.
3. **Health and safety regulations.**
   Especially for toner, ink and process chemicals used and for End product.
4. **TVOC emissions.**
   Indoor pollution caused by VOC or ozone, benzene and dust
   Use of environmentally friendly paper.
   FSC and PEFC certified paper or paper produced of 100% recycled pulp.
   Noise, waste paper reduction and environmental friendly machine design are also important but not the big issues for the world wide environment.

References

[1] INGEDE, Method 11

[2] INGEDE, March 2009, Reference Document, Certificate for the assessment of the Deinkability of a Printed Paper Product

[3] Austrian Environmental Sign, UZ 24, 1.January 2009 Printed products (Druckerzeugnisse)

[4] Österreichisches Umweltzeichen (Austrian Environmental Sign) Bürogeräte mit Druckfunktion, reegualtion UZ 16 1.July 2007 (Printer, copier and multifunctional devices)

[5] DIN EN ISO 7779:2002

[6] Directive on the Restriction of the Use of Ceertain Hazardous Substances in Electrical and Electronic Equipment Guideline 2002/95/EC

[7] Directive on Waste from Electrical and Electronic Equipment Guideline 2002/96/EC

[8] ÖNORM EN 12281: 2003 0101, Print- and office paper- requirements for copying with dry toner technology

[9] Biocide guideline 98/9/EC about biocide substances and biocide products since 1-09-2006 with new regulations ending 13-05 2010

[10] EC safety sheets EC Nr. 1907/2006(4) that safety sheets are mandatory.

[11] UZ 24 appendix 2 list for forbidden azo groups in pigments and dyes

[12] ISO 9706, Information and documentation- Paper for documents- Requirements for permanence. 1.March 1994

[13] Guideline EC Nr. 1907/2006 (REACH) about limitation of chemical substances

[14] ÖNORM EN ISO 14.001 Environmental management systems- requirements guidelines and use (ISO 14.001:2004, 1.01.2005

[15] Nordic Ecolabelling of Printing Paper, Criteria Document.

[16] www.paperprofile.com

[17] ECMA- Standard 328, Detection and measurement of chemical emissions from electronic equipment, august 2201

[18] DIN ISO 16000-6: Indoor pollution part 6 determination of VOC

[19] DIN 333870 2001-01 IT-office and data management- requirements and testing of recycling and reuse of used toner modules black for electro photographic printer, copier and fax machines.

Author Biography

Werner Sobotka received his MS in chemistry from the University of Vienna (1976) and his PhD of the Technical University of Vienna (1985). Since then he has worked in the Higher Institute for Graphic Arts in Vienna as Research Director till 1995. From 1995 to 2001 he was Dean of the College for Telecommunication and Media in St. Pölten and since 2001 Dean of Multimedia and Photography in the Institute for Graphic Arts in Vienna. 1976 till 1977 he was guest-professor at RIT, Rochester. He is president of the Photographic Society of Vienna and Research Director of VFG (Research Organization for Graphic Arts and Media). He was vice president of IARIGAI and representative for Austria in ISO and CEN standard committees. He was several times keynote speaker at NIP conferences of SPSE.