WAN IFRA RESEARCH
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Conformance of Indian Newsinks to ISO 2846-2

A must read for: Technical Director, Production Manager, Purchasing Manager
Catchwords: Materials and Consumables, Presses and Printing, Production Management

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1. Introduction

ISO standards for newspaper printing have never been more popular in India than now. One hundred and nine newspaper titles have won the club membership worldwide in INCQC 2010-12 and it is a clear indication of the popularity of the standard. All the major publishers in India have either already implemented ISO 12647-3 in their production process or on the process of implementing the standards.

The first step of any print process standardisation project is the standardisation of the raw materials used, i.e. paper and ink. Unless these materials are consistently within the standards, it is very difficult to maintain the print process standard ISO 12647-3. While there is no comprehensive ISO newsprint standard yet, only the standard newsprint shade defined in ISO 12647-3 and ISO 2846-2, there is DIN 19306-4, released in 2005. Publishers can develop purchasing specification for newsprint based on DIN 19306-4. For newsink, we have ISO 2846-2:2007. This standard specifies the ink colours and transparency requirements of the newsinks.

At WAN-IFRA Research and Material Testing Centre (RMTC), we investigated whether the inks used by Indian publishers are in conformance with ISO 2846-2 or not. We collected samples of eight ink sets from seven different manufacturers and tested them to find their conformance to ISO 2846-2. The results of our research are detailed in this report.

2. ISO 2846-2

2.1. An introduction to ISO 2846-2

ISO 2846-2 specifies the colour and transparency to be produced by the coldset web-offset inks when printed in a printability tester under standard printing conditions. The colours of the CMYK inks are clearly specified in the standard. Failure to produce the right colours can cause colour shifts in editorial pictures, advertisements and it may become impossible to produce the colour gamut specified in ISO 12647-3.

Moreover, the range of ink film thicknesses, IFT, within which the inks have to produce the right colours is also specified, 0.7 µm to 1.3 µm. An IFT lower than 0.7 µm means less margin for error for the printers controlling the inking. A higher IFT than 1.3 µm means a lower ink mileage and a higher dot gain. Table 1 shows the required colours that newsinks have to produce.

Secondly, the inks should be transparent for four-colour printing. For this test, the inks to be tested are printed on a black substrate. The col-

Ink	*L*a*b* values (white backing)*			*Tolerance*			
	*L**	*a**	*b**	ΔE^*_{ab}	*L**	*a**	*b**
Cyan	*59.1*	*-23.9*	*-27.1*	*4*			
Magenta	*55.5*	*47.6*	*0.7*	*4*			
Yellow	*80.4*	*-1.4*	*61.6*	*4*			
Black	*36.8*	*1.5*	*4.5*		*≤36.8*	*+/- 1*	*+/- 2*

Table 1 ISO 2846-2 CIELAB values for the four process colour newsinks

our of the black paper is measured before and after printing with ink film thicknesses ranging from 0.7 µm to 1.3 µm. A graph is plotted of IFT vs. Delta E^*_{ab} and the line of best fit is drawn. The reciprocal of the slope of the regression line is the transparency of the ink. Transparency is an important characteristic of the ink as it strongly influences the colour of its secondary and tertiary colours. Table 2 shows the transparency requirement of the newsinks.

Ink colour	*Transparency T*
Cyan	*0.3*
Magenta	*0.2*
Yellow	*0.1*

Table 2 ISO 2846-2 transparency values for newsinks

It is very important to note that ISO 2846-2 does not specify standards for viscosity and tack as it varies widely depending on the requirements of each printing site. The speed of the press and climatic conditions influence these parameters and it cannot be standardised globally. In New Delhi, for example, presses need different grades of ink viscosity in summer than in winter due to the huge difference in atmospheric temperature between the two seasons.

2.2 Indian inks and their conformance to ISO 2846-2

Eight sets of CMYK inks from seven different manufacturers were collected and tested. There was a mix of multi-national ink manufacturers, Indian ink manufacturers and inks from publishers who have their own ink manufacturing facility. Throughout the report, the names of the ink manufacturers will not be mentioned and the ink sets will be identified as Ink-set 1, Ink-set 2 upto Ink-set 8.

This research project had two objectives

1. For the benefit of publishers to help in their quest to achieve excellent and consistent print quality as per ISO 12647-3.
2. For the benefit of the ink manufacturers to achieve ISO standards, who themselves depend upon the pigment suppliers for the right colours.

3. Tests at WAN-IFRA RMTC

3.1 Test conditions

All the tests were carried out in accordance with ISO 2834-1:2006. ISO 2834 specifies the laboratory test conditions that have to be maintained while carrying out such tests. Table 3 shows the conditions maintained in the laboratory.

Inking unit temperature	*23^0 C*
Printing forme	*Blanket covered roller*
Ink distribution time	*10 s*
Ink distribution speed	*1.2 m/s*
Inking time	*5 s*
Printing pressure	*125 N/cm*
Printing speed	*0.2 m/s*
Printed area	*0.01025 m^2*
Colour Measuring conditions	*D50, 2^0, abs, unpolarised, white backing*

Table 3 Laboratory conditions

3.2 Newsprint used for the tests

A standard 45 g/m^2 newsprint was used for the test. Though ISO 2846-2 specifies 48.8 g/m2 newsprint for the test, we chose to use 45 g/m^2 as it is most commonly used by publishers in India. Table 4 shows the shade of the newsprint.

Shade of the newsprint used (white backing)			*ISO 2846-2 reference*		
*L**	*a**	*b**	*L**	*a**	*b**
85.72	*1.35*	*6.28*	*85.2*	*0.9*	*5.2*

Table 4 ISO 2846-2 CIELAB values for the newsprint shade

3.3 Criteria for an ink's conformance to ISO 2846-2

Apart from the inks themselves, the colours that are produced in print depend, on the press conditions, pressure settings, dampening solution and the substrate used. The best an ink manufacturer can do is to produce inks that are in conformance with ISO 2846-2. We have used the following guidelines that an ink has to satisfy to be in conformance with ISO 2846-2:

1. Produce the right colour and show the required transparency.
2. The inks Cyan, Magenta and Yellow were considered as a set. Failure of any one ink to conform to ISO 2846-2 means that the entire set of inks was not in conformance.
3. Black was considered separately as publishers can buy CMY from one supplier and K from another supplier.

3.4 Test procedure

1. Using the printability tester, the inks were printed with different IFTs over a standard paper. The colour was measured for each IFT and the colour difference, Delta E^*_{ab}, was calculated between the measured colour and the ISO 2846-2 reference colour. A graph was plotted of IFT vs. Delta E^*_{ab} and the IFT that produced the lowest Delta E^*_{ab} was considered as the optimum IFT for that ink. Likewise, the optimum IFT for C, M and Y are calculated.
2. The optimum IFT was then used to print the secondary colours (R, G and B). The colour was measured and the Delta E^*_{ab} was calculated against the colour specified in ISO 12647-3. If the Delta E^*_{ab} was larger than 4, the IFTs of the inks were varied and prints made to find the best colour match that could be achieved.
3. For the transparency test, test prints with varied IFTs were printed on a black paper. The test has been explained in the section "An introduction to ISO 2846-2".

4. Findings

1. 38% of the inks used by Indian publishers are not in conformance with ISO 2846-2.
2. The non-conformance occurred only with the Magenta and Yellow inks.
3. All the Cyan and Black inks tested were in conformance with ISO 2846-2.
4. The Magenta and Yellow inks that were not in conformance showed problems with colour and pigment concentration.
5. There were huge difference in ink mileage between the inks tested.
6. All the inks tested passed the transparency test.

4.1 Details

Ink-sets from three manufacturers out of the eight ink sets tested were not in conformance with ISO 2846-2. They are Ink-set 2, Ink-set 4 and Ink-set 8. Ink-set 2 had a problem with the colour of Magenta, Ink-set 4 had problem with the pigment concentration of Yellow and Ink-set

8 had problem with the colour of Yellow. Table 5 shows the results of all the inks.

Ink Set	Conformance to ISO 2846-2			
	C	M	Y	K
Ink-set 1	Yes	Yes	Yes	Yes
Ink-set 2	Yes	No	Yes	Yes
Ink-set 3	Yes	Yes	Yes	Yes
Ink-set 4	Yes	Yes	No	Yes
Ink-set 5	Yes	Yes	Yes	Yes
Ink-set 6	Yes	Yes	Yes	Yes
Ink-set 7	Yes	Yes	Yes	Yes
Ink-set 8	Yes	Yes	No	Yes

Table 5 Test results showing which inks conformed to ISO 2846-2

4.2 Problems with ink colour

4.2.1 Case 1: Ink-set 2

The Magenta of Ink-set 2 failed to be in conformance with ISO 2846-2 because of its colour. We found that the colour was lighter and slightly yellowish than the recommendation. The best colour that the Magenta of Ink-set 2 produced was L*60.02 a*48.91 b*1.49. The ISO recommendation for Magenta is L*55.5 a*47.6 b*0.7. The Delta E^*_{ab} is 4.77 which was very high. Table 6 shows the measured L*a*b* values of Magenta and Fig. 1 is the IFT Vs Delta E^*_{ab} graph of Magenta of Ink-set 2

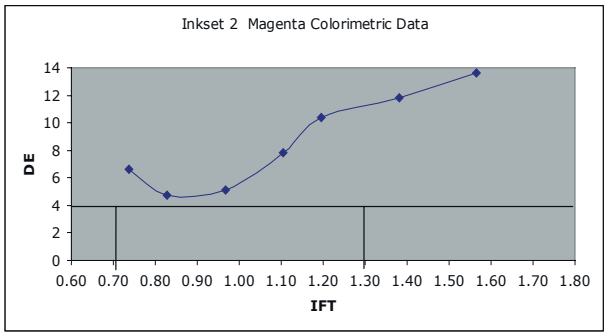

Fig. 1 Ink-set 2 Magenta IFT vs. Delta E^*_{ab}

SID M	IFT (µm)	Colour (White backing)			ΔE^*_{ab}
		L*	a*	b*	
0.64	0.74	61.91	45.85	0.46	6.65
0.72	0.83	60.02	48.91	1.49	4.77
0.8	0.97	58.35	51.25	2.85	5.10
0.9	1.10	56.27	54.36	4.55	7.81
0.99	1.20	55.03	56.25	6.39	10.37
1.03	1.38	54.19	57.36	7.23	11.81
1.09	1.56	53.49	58.43	8.70	13.61

Table 6 Ink-set 2 Magenta CIELAB values with an increasing IFT

At first sight, a lighter colour with good saturation may not look like a problem. However, it had its effect on the secondary colours. When printed with optimum SIDs, the Red and Blue produced with Ink-set 2 were again lighter. Red showed Delta E^*_{ab} 5.83 and Blue showed Delta E^*_{ab} 3.96. When we tried to alter IFT to produce a better Red and Blue, the best Red that we could achieve had a Delta E^*_{ab} 5.66, which was still very high. We were able to produce a better Blue with a Delta E^*_{ab} 2.49 by increasing the IFT of Magenta slightly. However, increasing the IFT of Magenta increased the Delta E^*_{ab} of Magenta, which was already out of tolerance.

4.2.2 Case 2: Ink-set 8

The Yellow of Ink-set 8 failed to be in conformance with ISO 2846-2 because of its colour. We found that the colour was very reddish. The best colour that we could produce within the IFT tolerance was L*81.59 a*3.17 b*59.58. The ISO recommendation is L*80.4 a*-1.4 b*61.6. The Delta E^*_{ab} was 5.14, which was very high. Table 7 shows the measured L*a*b* values of Yellow and Fig. 2 is the IFT vs Delta E^*_{ab} graph of Yellow of Ink-set 8.

SID Y	IFT (µm)	Colour (White backing)			ΔE^*_{ab}
		L*	a*	b*	
0.62	0.81	82.29	1.78	53.11	9.26
0.65	0.90	82.15	1.88	53.86	8.59
0.72	0.98	81.73	2.69	57.42	5.99
0.77	1.13	81.59	3.17	59.58	5.14
0.82	1.28	81.00	3.81	61.89	5.25
0.89	1.36	80.67	4.40	63.51	6.11

Table 7 Ink-set 8 Yellow CIELAB values with an increasing IFT

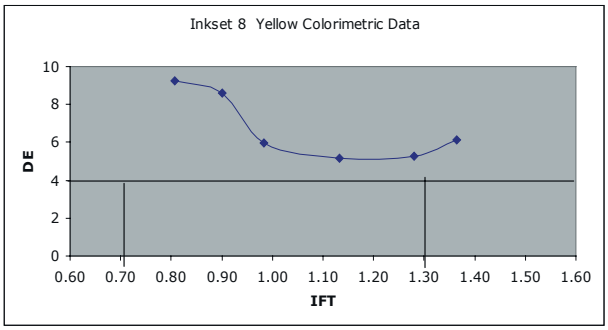

Fig. 2 Ink-set 8 Yellow IFT vs. Delta E^*_{ab}

From the table, we can see that Yellow ink is obviously reddish and the Delta E^*_{ab} is very high. It can cause a colour shifts in advertisements and editorial pictures. Ink-set 8 also had a problem with the Green. When printed with optimum IFT of Cyan and Yellow, we obtained Green with values of L*55.13 a*-29.66 b*11.07, while the ISO 12647-3 requires L*54.4 a*-35.2 b*18.3 (white backing). The Delta E^*_{ab} is 9.14 which was totally unacceptable. On increasing the IFT of Yellow, we achieved the best colour match and a Delta E^*_{ab} 6.66, which is also unacceptable. The problem with Green occurred due to two reasons. Firstly, poor Yellow trapping over Cyan and secondly, a reddish-yellow colour that made the a* value of green shift towards neutral.

These were the two cases, from Ink-set 8, when the ink failed to reach conformance due to wrong colours. If the inks are not in conformance to ISO 2846-2 with respect to colour, it is very difficult to achieve the colour gamut specified in ISO 12647-3 during the production process.

4.3 Problems with pigment concentration

4.3.1 Case 1: Ink-set 1

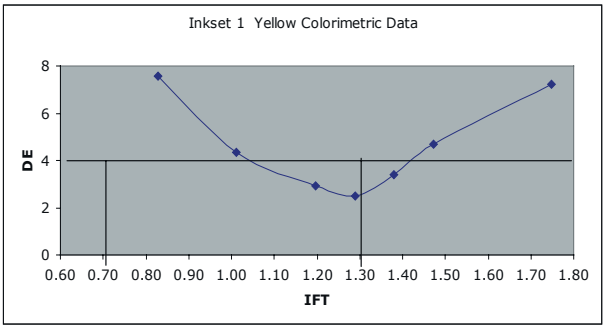

Fig. 3 Ink-set 1 Yellow IFT vs. Delta E^*_{ab}

The ink was in conformance with ISO 2846-2. However, the curve can be shifted to the left by increasing the pigment concentration. This Yellow ink allowed the printers very little margin for adjusting the inking. For example, the colour of the Green that Ink-set 1 produced at the optimum IFT of Cyan and Yellow is L*56.45 a*-33.26 b*15.54 and the Delta E^*_{ab} was 3.95. Obviously, this Green could be improved with a little more Yellow. However we couldn't increase the Yellow IFT as it would have crossed the 1.3 µm mark. Moreover this ink offered less ink mileage when compared to other inks with good pigment concentration.

4.3.2 Case 2: Ink-set 4

Ink-set 4 failed to conform to ISO 2846-2 as the Yellow of Ink-set 4 had a very low pigment concentration and it only produced the right colour well above the IFT tolerance band specified in the

standard. Table 8 shows the measured L*a*b* values of Yellow and Fig. 4 shows the IFT Vs Delta E^*_{ab} graph of Yellow of Ink-set 4.

SID Y	IFT (µm)	Colour (White backing)			ΔE^*_{ab}
		L*	a*	b*	
0.56	0.98	83.49	-2.00	50.22	11.81
0.65	1.17	83.02	-1.61	54.44	7.63
0.69	1.27	82.63	-1.27	56.79	5.30
0.71	1.37	82.70	-1.37	57.74	4.49
0.75	1.56	82.35	-0.88	60.49	2.30
0.81	1.76	82.24	-0.62	62.51	2.20
0.87	1.95	81.99	-0.15	64.93	3.90
0.94	2.15	81.82	0.33	67.73	6.53

Table 8 Ink-set 4 Yellow CIELAB values with an increasing IFT

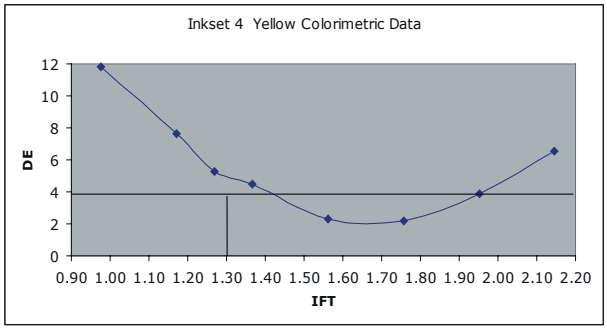

Fig. 4 Ink-set 4 Yellow IFT vs. Delta E^*_{ab}

The best colour was produced at an IFT of 1.76 µm which was unacceptable. Ink-set 4 also had a problem with Green. At the optimum IFT, the produced colour of Green was L*55.46 a* -35.82 b*13.30 with a Delta E^*_{ab} 5.15. Obviously, a higher Yellow IFT could have improved the colour, but this wasn't acceptable as it would have been above 1.76 µm.

4.4 Ink mileage

A study of inks for their conformance to ISO 2846-2 is also a good method to determine the ink mileage. In the laboratory, ink requirement is denoted in terms of g/m^2. The amount of ink required to print 1 m^2 area of paper with the colour specified in ISO 2846-2 denotes the ink requirement. Table 9 is the ink requirement of C, M, Y of all the 8 inks.

Ink-set	Ink requirement (g/m2)			Sum
	C	M	Y	
Ink-set 1	1.07	1.07	1.37	3.51
Ink-set 2	0.98	0.88	1.07	2.93
Ink-set 3	0.88	1.07	0.78	2.73
Ink-set 4	1.07	1.17	1.76	4.00
Ink-set 5	0.78	1.07	1.27	3.12
Ink-set 6	1.07	0.98	1.27	3.32
Ink-set 7	0.93	0.95	1.30	3.17
Ink-set 8	0.96	1.07	1.19	3.22

Table 9 Weight of ink required by each ink to meet the ISO 2846-2 standard

Ink-set 2 and Ink-set 3 showed very good mileage when compared to other inks. Ink-set 4 offered the least mileage mainly because of its Yellow which had a very low pigment concentration. Clearly Ink-set 3 was the best in terms of ink mileage. Table 10 shows the difference in ink mileage of all the inks when compared with Ink-set 3 in percentage terms.

Ink-set	% Difference from Ink-set 3
Ink-set 1	-22.22%
Ink-set 2	-6.67%
Ink-set 3	0% (the reference)
Ink-set 4	-31.71%
Ink-set 5	-12.40%
Ink-set 6	-17.65%
Ink-set 7	-13.85%
Ink-set 8	-15.15%

Table 10 Ink mileage relative to Ink-set 3

Note the difference between the Ink-set that offered the best mileage, Ink-set 3, and the Ink-set that offered the least mileage, Ink-set 4.

4.4.1 Cyan

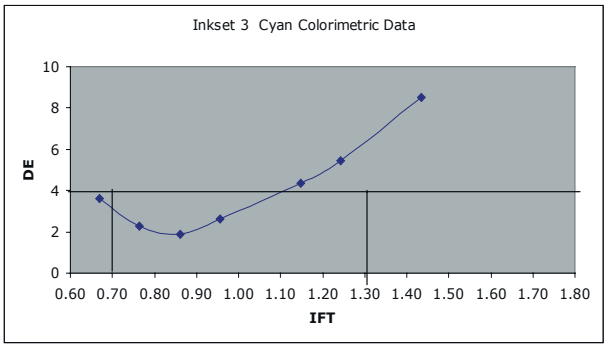

Fig. 5 Ink-set 3 Cyan IFT vs. Delta E$^*_{ab}$*

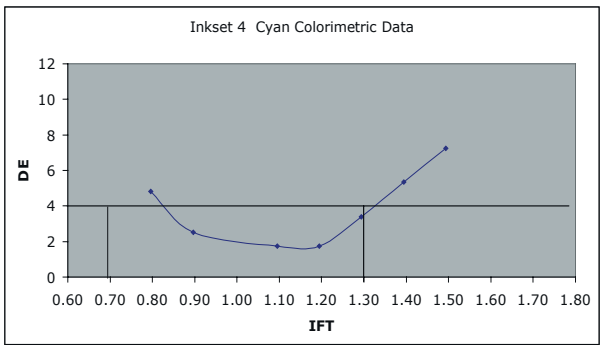

Fig. 6 Ink-set 4 Cyan IFT vs. Delta E$^*_{ab}$*

Cyan of Ink-set 3 required 0.88 g and Cyan of Ink-set 4 required 1.07 g. Cyan of Ink-set 3 offers 18% more mileage than Cyan of Ink-set 4.

4.4.2 Magenta

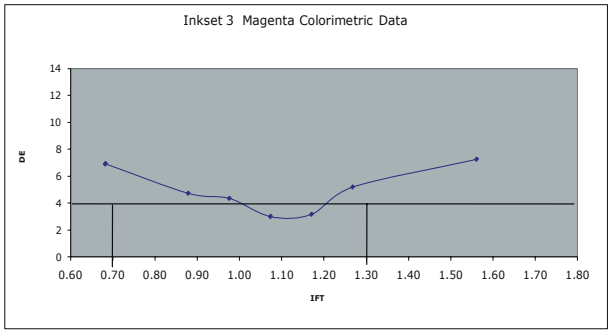

Fig. 7 Ink-set 3 Magenta IFT vs. Delta E$^*_{ab}$*

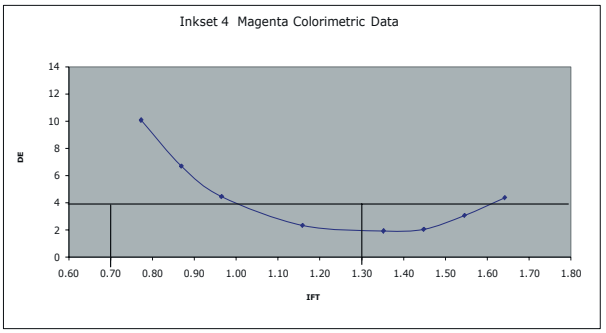

Fig. 8 Ink-set 4 Magenta IFT vs. Delta E$^*_{ab}$*

Magenta of Ink-set 3 needed 1.07 grams and Magenta of Ink-set 4 needed 1.17 grams. Magenta of Ink-set 3 offered 8.5% higher mileage than Magenta of Ink-set 4. From the chart you can also see that Magenta of Ink-set 4 clearly needed an alteration in the pigment concentration.

4.4.3 Yellow

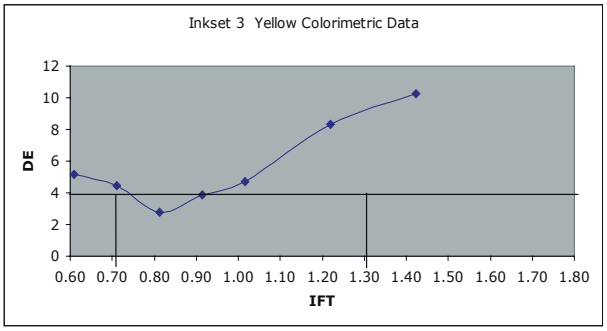

Fig. 9 Ink-set 3 Yellow IFT vs. Delta E$^*_{ab}$*

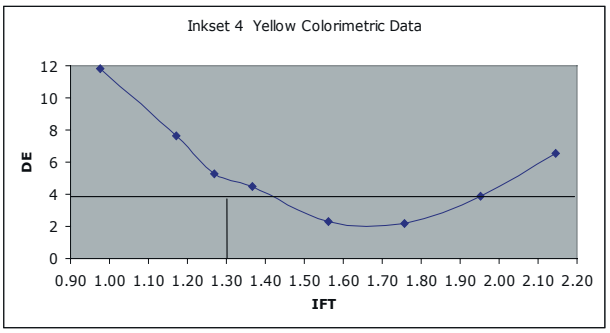

Fig. 10 Ink-set 4 Yellow IFT vs. Delta E$^*_{ab}$*

Yellow of Ink-set 3 needed 0.78 grams and Yellow of Ink-set 4 needed 1.76 grams. Yellow of Ink-set 3 offered a huge 56% higher mileage than Yellow of Ink-set 4.

On average, Ink-set 3 offered 32% higher ink mileage than Ink-set 4. Consider the cost savings – savings in terms of ink cost, transportation and handling cost. We are looking at hundreds of thousands of dollars.

4.5 Transparency of the inks

It is obvious that the inks have to be transparent or else four-colour printing would not be possible. If inks are opaque, secondary colours cannot be produced at all. Hence, ISO 2846-2 specifies the transparency requirement of the inks. All of the inks tested were in conformance to ISO 2846-2 for transparency. Table 11 shows the transparency of all the inks.

Ink	*Transparency*		
	C	*M*	*Y*
Ink1	*0.80*	*0.48*	*0.38*
Ink2	*0.58*	*0.83*	*0.54*
Ink3	*0.75*	*0.89*	*1.24*
Ink4	*0.55*	*1.01*	*0.76*
Ink5	*0.78*	*1.01*	*0.31*
Ink6	*0.3*	*0.54*	*0.3*
Ink7	*0.34*	*0.57*	*0.59*
Ink8	*0.44*	*0.78*	*0.32*
Target	*> 0.3*	*> 0.2*	*> 0.1*

Table 11 Transparency of the inks

5. Conclusion

The inks available in the Indian market are good. The inks that failed to conform to ISO 2846-2 had a problem with only one of Magenta or Yellow inks. A problem with pigment concentration is relatively easy to handle. However, a problem with the colour may be a little more difficult to overcome as it involves the pigment manufacturer.

Lower pigment concentration reduces the ink mileage and means a loss for publishers in terms of ink- and handling costs. A higher ink film thickness to produce the right colour can also lead to a higher dot gain, drying issues and can affect the print quality.

Colour deviations can cause a colour shift in advertisements and editorial pictures, can affect the greybalance and the ability to provide the colour gamut specified in ISO 12647-3.

There is no serious problem with Indian inks. However, ink manufacturers should work closely with pigment suppliers to get the right colour of ink and supply ISO 2846-2 compliant ink to the publishers. Publishers, for their part, have to check the consistency of the inks and inform ink manufacturers of any variations.

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6. Appendices

6.1 Abbreviation list

ΔE^*_{ab}	Delta E_{ab} 1971
IFT	Ink film thickness
SID	Solid ink density
GSM	Grams per square metre

6.2 References

[ISO 2846-2] ISO 2846-2:2007 Graphic technology - Colour and transparency of printing ink sets for four-colour printing - Part 2: Coldset offset lithographic printing.

[ISO 2834-1] ISO 2834-1:2006 Graphic technology - Laboratory preparation of test prints - Part 1: Paste inks.

[ISO 12647-3] ISO 12647-3:2005 Graphic technology - Process control for the production of half-tone colour separations, proofs and production prints - Part 3: Coldset offset lithography on newsprint.

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