Organic Pigments : Year 2000 & Beyond

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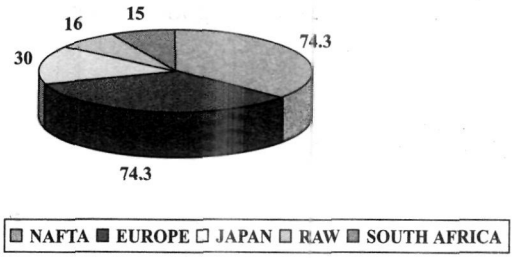
In the last about 100 years the business of manufacturing and marketing organic pigments has come a long way. Now, it is a well established and truly global business across the five continents.

Although it did not experience any significant growth in the year 2001, due to recessionary trends, it is expected that the demand would increase 3-5% annually over the next five years. Needless to say, even such small growth is difficult to achieve unless the challenges on several fronts such as cost, application, product safety regulations and environment are met.

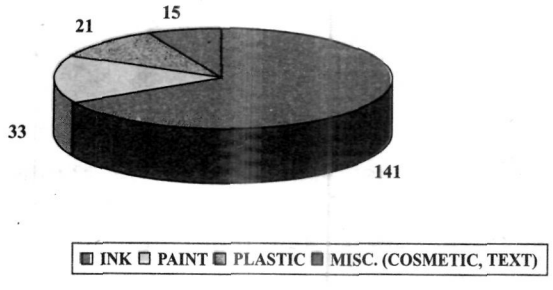
What I wish to do in this article is to review the current trends and also try to look into the future of organic pigments.

World Market

In the year 2000, the world market for organic pigments was about 210,000 metric tons and it can be said that approximately one-third belonged to each USA, Europe and Rest of the World. (Fig. 1)



Considering the end use, printing ink by far is ahead of all other applications. 67% of all consumption goes into printing inks both packaging and publication. Paint and plastic lag too much behind with ca.15.7% and 10% respectively. Fig.2

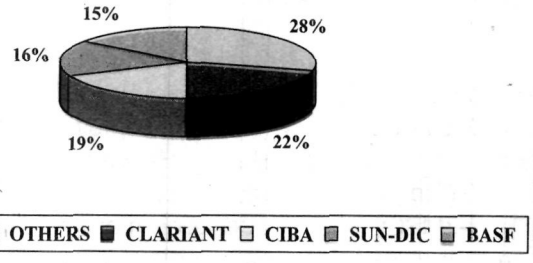


If one considers the world pigment market by chemical class, then as expected Phthalocyanines & Classical azos lead the list. Table 1

Table 1: World Market - By Chemical Class

	Tons	%
Phthalocyanine Blue & Green	64,300	31
Classical Azo Reds (e.g.Naphthol & lake type)	53,500	25
Diarylide Yellows	53,200	25
Monoarylides (e.g.Hansa Yellows)	5,500	3
Misc.classical pigments	17,000	8
High Performance (Yellow, Oranges & Reds)	16,500	8
Total :	**210,000**	**100**

The four key producers, i.e. Clariant, CIBA, SUN-DIC & BASF have a lion's share of about 70% in the world production. Fig. 3



Capacities

It is very difficult to furnish accurate information about capacity utilisation. Nevertheless, based on various production and sales figures as well as data available in published reports a fair estimate can be made as in Table 2 It can be said that the capacity utilisation varies between 60 to 80%.

Table 2: Organic Pigments : Sales Vs. Capacity (metric tons x 1000)

Region	Capacity	Sales
NAFTA	100	94
Europe	73	60
Asia	35	20
China	33	18
India	21	12
South America	8	6
Total :	270	210

Improvements in Pigment Properties

Generally speaking until 1960s newer pigment molecules were introduced. However, in recent times the development activity has been taken over by the physical modification of the existing pigments e.g. transparent pigments with very high fastness properties for metallic coatings, pigments with improved flow properties for high speed printing machines and pigment modifications which withstand high temperature in plastic processing.Such improvements could be brought about by altering the following properties/processes in pigment manufacture :

Particles size : A larger particle size with narrow particle size distribution leading to improved fastness and rheological properties e.g. Hansa Brill.Yellow 2 GX-70 (Pig.Yellow 74) and Novoperm Red F2RK70 (Pig.Red 170). The opaque yellow mentioned above can replace lead chromate which is objectionable due to environmental concern. Likewise, the Red F2RK70 can be used for automotive paints.Its improved rheology makes higher pigment Concentration possible thus providing an economic alternative to quinacridone or diketopyrrolopyrrole pigents.

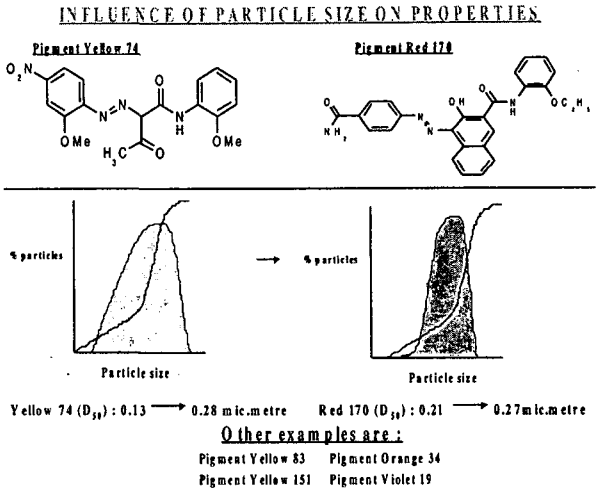


Fig. 4

Surface treatment / Recrystallisation Resistance : Conventional Pigment Yellow 1, Yellow 3 & Yellow 74 lose colour strength drastically during dispersion process. The modified recrystallisation resistant variants of these yellow pigments are free of this defect.

Polycyclic pigments are generally difficult to disperse and have tendency to flocculate. During recent years several additives have been introduced to improve these properties. Thus, improved quinacridones, perylene & especially carbazole violet pigments are now available in tailor made transparent or opaque grade with improved dispersibility & flocculation stability and higher strength.

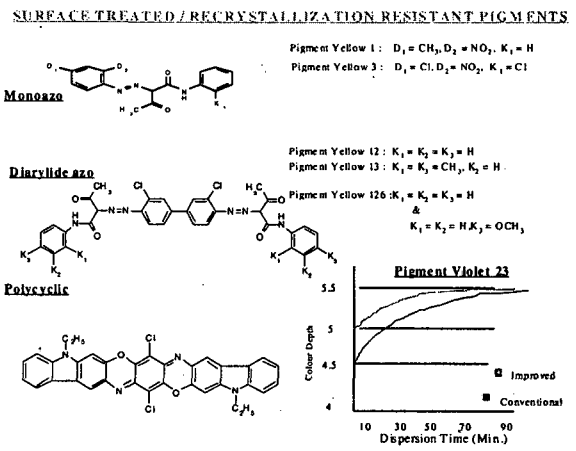


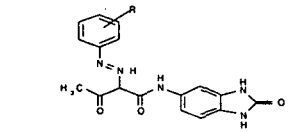
Fig. 5

Modification in Chemical Constitution : A well known example of this type is the Benzimidazolone azo pigments the cyclic

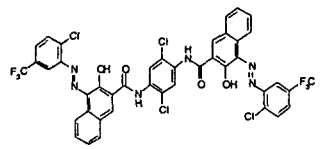
carboxamido group and the intermolecular hydrogen bonding impart much better fastness to these pigments as compared to similarly structured Hansa Yellow G (Pigment Yellow 1) types.

A similar approach to increase fastness properties of orange and red pigments has resulted in Disazo Condensation pigments, which are very versatile for various high performance applications e.g. Novo. Scarlet RF (Pig, Red 242).

MODIFICATION IN CHEMICAL CONSTITUTION



Benzimidazolone Pigment



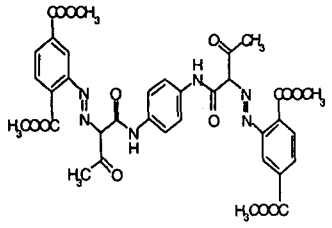
Disazo Condensation Pigment

Fig. 6

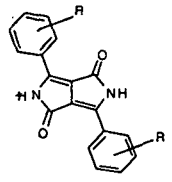
New Chemical Types

In eighties a few new types of pigments were introduced, e.g., disazo pigment Sandorin Yellow 4G (Pig.Yellow 155) and Diketopyrrolopyrrole (DPP) pigment Irgazin DPP Red BO (Pig.Red 254). However, in the recent past there is practically no introduction of a new pigment molecule on a commercial scale.

NEW CHEMICAL TYPES



Sandorin Yellow 4G
(Pigment Yellow 155)



Irgazin DPP Red BO
(Pigment Red 254)

Fig. 7

Application Trends

Coatings In Western countries there is a continued growth of waterborne paints. In USA more than 90% of architectural paints are water based. In Netherlands use of solvent based paints is banned in construction industry.

Powder coatings have enjoyed a very good growth in recent times. In line with developed countries South America, Asia and South Africa are inclined to replace inorganic chrome yellows and cadmium reds with organic pigments. Cost is a major concern here.

Use of Universal Tinters is increasing in refinish paints. Such preparations are compatible with both water as well as solvent based systems. The "colour shops" at the retailers are an ample evidence of this trend.

Inks : To suit the high speed printing machines technical properties of the inks need modifications. As a consequence, both pigments and resins have undergone significant changes. For example, use of recrystallization stable pigments for bead mills instead of three roll mills. Printing inks designed for web offset process should have higher pigment content at the same time there is a strong emphasis on rheology, transparency and gloss. The change from solvent based to water based inks seems to have slowed down.

Plastics : Due to the changes in plastic processing for economical reasons the dispersion of pigments in plastics sometimes poses problems. Such problems can be overcome either by using pigment press cakes, master batches or specially surface treated pigments.

Use of pearlescent pigments to provide unique effects in molded plastic seems to be on the increase.

Role of Technology

Pigment manufacturing is essentially a batch process involving several unit processes and operations. Improvement in Chemical Engineering has led to process optimization. Computer aided Data Acquisition and Control Systems as well as Instrumentation has helped in achieving better process control, reliability and reproducibility. Operations involving large material handling have also

improved e.g. conveyor belts and granulation for press cakes, belt & spin flash drying, air jet milling and pneumatic conveying of pigment powder.

There is an increasing trend among the pigment manufacturer to provide "ready made" pigment preparations.These result in ease of incorporation in the consumer's application system as well as in realising the optimum strength in a much faster and economical way e.g. Hostaprint and Hostasin preparation of Clariant for printing inks for plastic and rubber respectively.

As far as dry pigments are concerned, efforts continue to provide "dust free" or "low dusting" pigments to improve work environment at the manufacturer's as well as at the customer's shop floor.

In tune with the tremendous growth in the Information Technology, the "E-business" provides the pigment manufacturers an opportunity which will be certainly cost saving on the long run.

Toxicological and Regulatory Issues

Pigments are widely used for colouration of consumer goods, toys and printing inks for food packaging. Thus, the migration behaviour as well as heavy metal, amines and PCB content etc. have become a matter of serious concern. As such the pure pigments are, generally speaking not toxic and being water insoluble are not bioavailable. In future, more regulations on the lines of European Resolution AP(89) I for colouration of plastic food packaging and European toy Standard EN 71/3 for pigments for toys can be expected.

Cost Considerations

Due to about 30% idle capacity it has been virtually impossible to increase the prices. On the other hand the prices of raw materials have increased. The cost of utilities has also seen an increase of ca.10% over the past few years. The ever demanding operational & product safety, health, welfare & environmental issues have also added to the cost significantly.

In view of the above cost reduction has gained utmost importance with all the pigment manufacturers.

Summary and Outlook

The biggest opportunity for pigment manufacturers is to grow with new products and the application of advanced technology.

Pigment business is about constant change ! in the supply and evolution of better products and service.

While changing, the cost considerations are of utmost importance.

The industry has to meet the regulatory and social obligations towards ecofriendly products and manufacturing practices.

Dr.U. T. Nabar, has done his Ph.D. from the UDCT in 1977. He has a vast experience in heterocyclic compounds and anthraquinone based disperse dyes. He has working in Colour-Chem Ltd. for last 23 years. He has visited Hoechst and Clarient overseas plants in Germany, France, and Spain for the discussion and training with dyestuff and pigments manufacturing, developments and applications, and Product safety. He has experience in the area of naphthols and fast bases, production of azo and polycyclic pigments, disperse and reactive dyes, as well as in the development and synthesis of some new pigments.