Egyptian Journal of Chemistry

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Novel Synthesized Disperse Dyes based on Enaminones Provide Added-Value: Part 3

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Abstract

It is worth mentioning that reviews on the use of polymer-linked enaminone derivatives are restricted, and while exploring this there are still many problems that we can fix. This thorough review offers a critical analysis of new structural models, real-time applications, including the dyeing of polyester fabrics, and the structural characteristics of enaminone-based disperse dyes. We genuinely hope that this work will inspire materials scientists and chemists to further propel the rapidly expanding field of polymer-bound enaminones for application as dental resins.

***Keywords*:** Disperse dyes, *polyester fabrics*, dental resins, *enaminones*

1. Chemistry

Polymers with β-ketoester side groups, which are made possible by dynamic enaminone connections and the creation of products like dental resins, are of interest [1 - 60]. It should be noted that Scheme No. 1 [1, 2] clearly shows the nature of the reaction between enaminones **1a-f** and acetone **2** to produce highly productive new enaminones dispersed dyes **5a-f**. Also, the safe synthesis of enaminones from substituted acetophenones and dimethyl formamide dimethyl acetal using microwave radiation was presented by us [4, 46] (Scheme 1). Enhancing the qualities of dental materials used in restorative dentistry has drawn more attention. These include increasing mechanical qualities and decreasing solubility, water absorption, and water absorption, and vice versa, since dental restorative materials need to have qualities like radio-opacity and antibacterial activity increased. The study of the efforts made by the bacteria that cause caries, a contagious illness, to develop restorative materials with antibacterial activity is one of the subjects that has generated a lot of interest in dental materials research [15, 38, 40]. This helps us understand the significance of these healing elements, which also have antimicrobial properties. Numerous antibacterial monomers have been created to create durable antibacterial restorative materials in order to accomplish this goal. Because of its exceptional mechanical strength, the material offers a novel approach to tooth beauty [43, 47, 50, 52, 53, 55, 57].

2. Characterizations

In the past, we have shown that a methyl ketone can condense with dimethylformamide and dimethyl acetal to produce enaminone in large quantities. The coupling reaction between those enaminones and arylidene diazonium chloride, which yields compounds 1, was then also previously examined. Scheme 1 shows how compounds **1a-f** and acetone react to form compounds **5a-f** , which yield six new dispersed colours that we utilized to dye polyester textiles.

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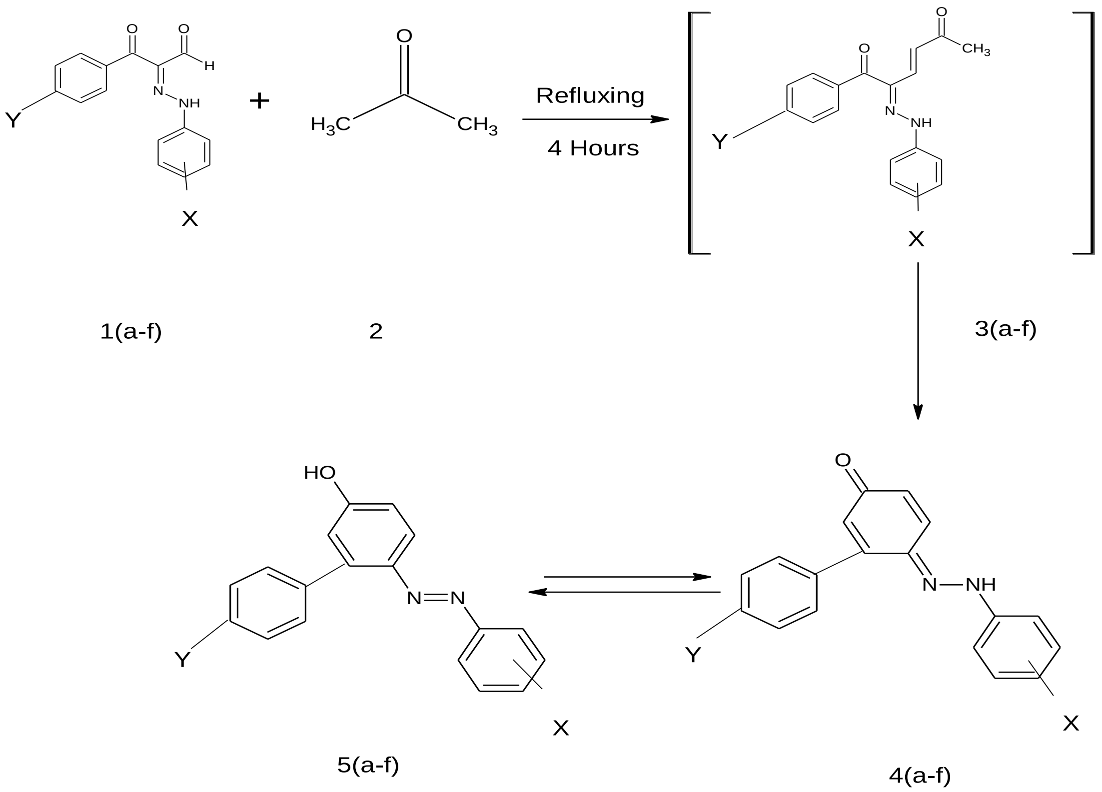
Receive Date: 31 January 2025, Revise Date: 25 February 2025, Accept Date: 06 April 2025

DOI: 10.21608/ejchem.2025.357003.11239



5 (a) X,Y= CL, H
5 (b) X,Y=CL,CH_3
5 (c) X,Y=CL, Br
5 (d) X,Y=No_2,H
5 (e) X,Y=No2,CH_3
5 (f) X,Y=No_2,Br

Scheme 1 : Synthesis of new azo disperse dyes [8].

3. Low temperature dyeing process (carrier dyeing)

The carrier dyeing procedure uses low temperatures. Carrier dyeing is regarded as one of the most significant and effective methods for dying polyester fabrics since it raises the absorption value of the colours on the fabric. Furthermore, it is crucial for dying textiles that require less heat because heat above 100 degrees Celsius ruins them. The six pigments provide a range of colours during the dyeing process, from light yellow brown to dark yellow brown. According to the K/S value, the dyes' colour strengths are arranged as follows: 5f < 5a < 5d < 5c < 5e < 5b (see Table 1, figure 1) [8].

Table 1. The colour strengths K/S for new dyes [8, 9].

Dye No	K/S values for dyeing method at 100 °C	K/S values for dyeing method at 130 °C
5 a	5.41	14.92
5 b	3.54	8.65
5 c	4.02	10.31
5 d	4.26	8.46
5 e	3.74	11.94
5 f	5.66	10.40

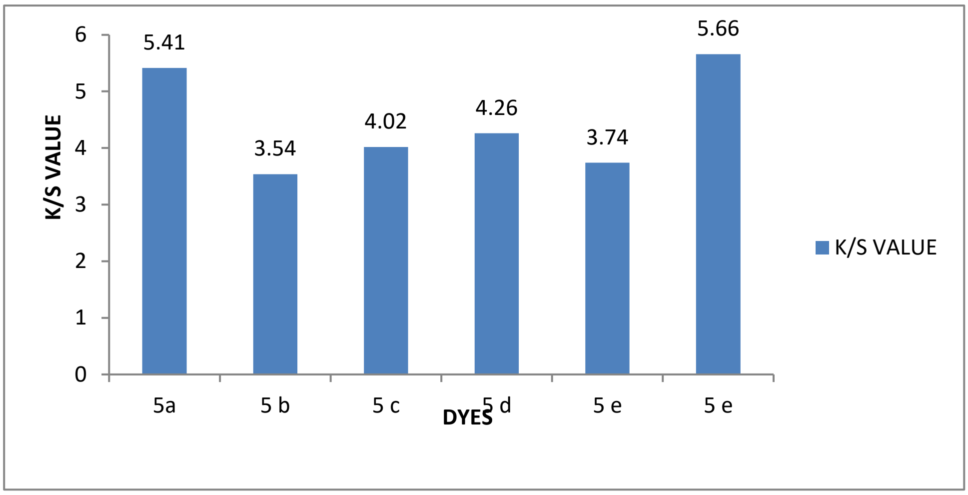


Figure 1. The K/S of the synthesized dyes [8].

4. High temperature dyeing method

We dyed polyester fabrics at a temperature of 130 degrees Celsius in order to obtain a greater depth of color and make full use of the dye present in the dyeing bath. The classification of the dyes in terms of color intensity was as follows: 5a < 5e < 5f < 5c < 5b < 5d (see Table 1, figure 2) [9].

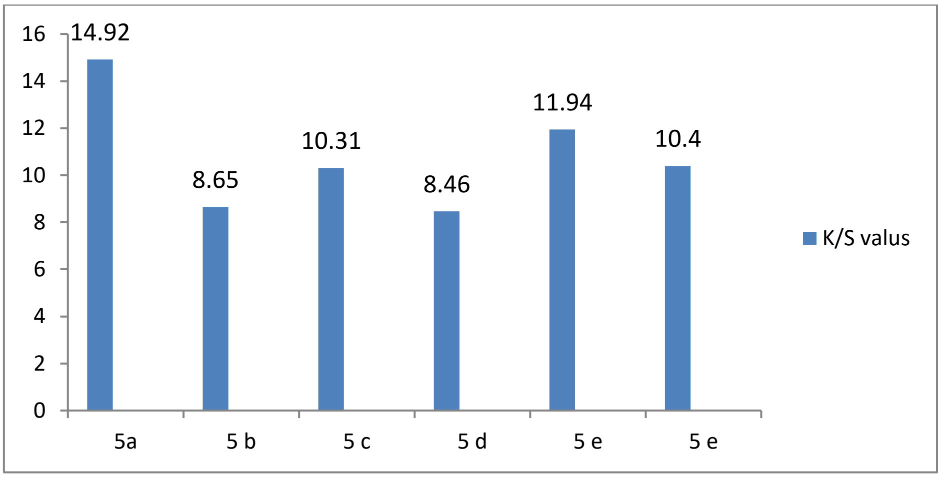


Figure 2. The K/S of the synthesized dyes [9].

Because the colour intensity expressed in K/S values increases, as we have explained numerous times [18], Table 1. clearly shows that dyeing polyester fabrics with new disperse dyes based on enaminones at a high temperature of 130 degrees Celsius is more effective than dyeing at a low temperature of 100 degrees Celsius [18].

5. Dyeing baths reuse

As part of our creative strategy for using new disperse dyes to dye polyester materials, we dispose of coloured waste. Following the initial dying process, we employ the leftover dye, or dye bath waste, as a form of ecologically hazardous waste treatment rather than disposing of them in an environmentally hazardous manner. Following the initial dyeing process, the dye bath solutions **5a–f** are examined and remixed with the quantity of fresh water needed to keep the solution's volume ratio constant. As a result, we have free coloured polyester fabrics. If there are still dyes in the dyeing bath after we have purified the water, we can re-dye it once or twice [8, 9, 17] (see Table 2).

Table 2. K/S values of dyed samples [8, 9, 17].

Dye No	Polyester dyed fabrics	K/S values for dyeing method at 100 ºC	K/S values for dyeing method at 130 ºC
5a	Dyeing	5.41	14.92
	1st dye reuse	3.73	1.87
	2nd dye reuse	2.94	0.58
5b	Dyeing	3.54	8.65
	1st dye reuse	2.16	3.31
	2nd dye reuse	0.73	0.77
5c	Dyeing	4.02	10.31
	1st dye reuse	2.36	2.19
	2nd dye reuse	1.31	0.73
5d	Dyeing	4.26	8.46
	1st dye reuse	2.27	1.17
	2nd dye reuse	0.63	0.54
5e	Dyeing	3.74	11.94
	1st dye reuse	2.10	0.63
	2nd dye reuse	0.89	0.35
5f	Dyeing	5.66	10.40
	1st dye reuse	2.13	0.74
	2nd dye reuse	0.55	0.43

The colour intensity indicated in K/S values that we obtain after reusing the first dye baths for dispersion dyes **5a-f** ranges from 49 to 69% of those values that we obtained in the initial dyeing procedures at 100 degrees Celsius, as shown by the data in Table 2 and Figure 3 [17].

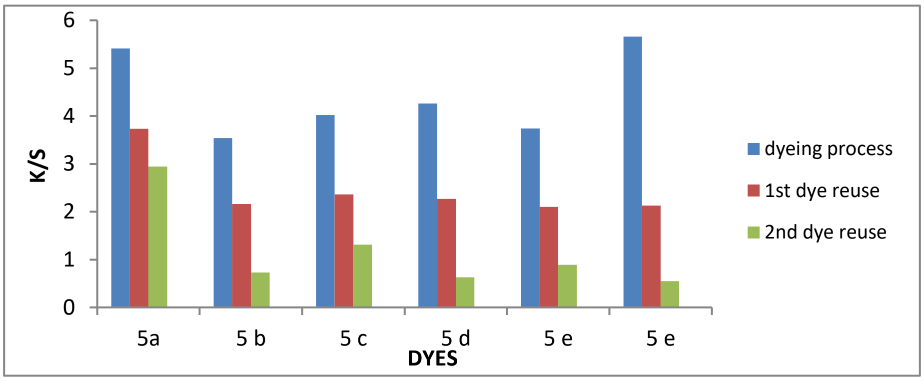


Figure 3. K/S of dye baths reuse for dyeing process at 100 ºC [17] .

Similarly, the K/S values we get when we reuse the first dye baths for dispersed dyes **5a-f** range from 5 to 9% of the values we got in the initial dyeing operations at 130 degrees Celsius, according to the data shown in Table 2 and Figure 4. This demonstrates unequivocally that recycling dyeing baths is a practical method of cutting water and chemical usage expenses without causing contamination to the environment [17].

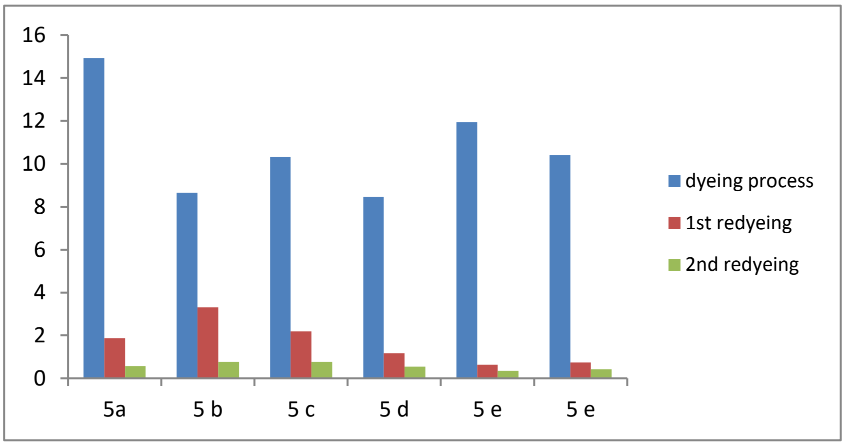


Figure 4. K/S of dye baths reuse for dyeing process at 130 ºC [17].

6. *Fastness properties*

We found that the six dyes exhibited good to excellent wash and sweat properties according to the grey scale and moderate light fastness properties according to the blue scale, based on the data on the stability properties of the disperse dyes obtained in Table 3 using the dyeing process at 100 or 130°C [8, 9] .

Table 3. Fastness properties of the dyed fabrics [8, 9] .

Dye NO	washing			Perspiration acidic			Perspiration alkaline			Light fastness
	SC	SP	ALT	SC	SP	ALT	SC	SP	ALT	
Dyeing process at 100°C										
5a	5	4	4−5	5	5	5	5	5	5	3-4
5b	5	4	4−5	5	5	5	5	5	5	4
5c	5	4	4−5	5	5	5	5	5	5	3-4
5d	4−5	4	4−5	5	5	5	5	5	5	4
5e	4−5	4	4−5	5	5	5	5	5	5	4
5f	5	4	4−5	5	5	5	5	5	5	4-5
Dyeing process at 130°C										
5a	4	4	4−5	5	5	5	5	5	5	3
5b	4−5	4	4−5	5	5	5	5	5	5	3-4
5c	4−5	4	4−5	5	5	5	5	5	5	3-4
5d	5	4	4−5	5	5	5	5	5	5	4
5e	5	4	4−5	5	5	5	5	5	5	3
5f	5	4	4−5	5	5	5	5	5	5	4-5

7. Conclusions

In this review, we explain the significance of enaminones and their added value, as well as the application of using these dyes to dye polyester fabrics at different temperatures and the stability properties of fabrics dyed with these new dyes. This is a continuation of our previously presented innovative strategy for the synthesis and characterisation of new disperse dyes based on enaminone compounds, from which enaminone compounds are made into polymeric materials used as resins and restorative materials in dentistry. It is important to note that several investigations are being done by us on the potential applications of these novel colours in dentistry as resins or restorative materials.

8. References

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