Chapter X

Real sample analysis
CHAPTER X

REAL SAMPLE ANALYSIS

The colour removal efficiency in different treatment methods such as activated carbon adsorption, Fenton’s oxidation, photochemical, coagulation and electrochemical were studied and optimized for synthetic disperse dye solutions and their results were discussed in previous chapters.

In order to understand the actual response, real sample analysis was carried out as per the procedure given below;

Experimental

For real sample analysis, 4 gram of polyester fabric was wetted using water and entered into a bath containing 91.2 mL of water and 12 mL of 5% phenol and kept for boiling up to 10 minutes. Then, the fabric was removed from the bath and 4.8 mL of 5% dispersing agent, 4mL of 1% acetic acid and 8 mL of 1% stock dye solution were added to the bath. Then, the fabric was re-entered into the dye bath and kept for boiling at 90°C for about one hour. After dyeing, the fabric was removed and cooled for 10 minutes, washed and dried. The dye effluent thus obtained was subjected to the said dye removal methods under their respective optimized conditions. The dye removal efficiency with synthetic dye
solution and to that of real dye effluent was compared and their results are given below;

Colour removal in adsorption method

Adsorption treatment was performed for all dyes under their optimized conditions for synthetic and real dye effluent (Table 10.1). Adsorption on synthetic sample showed higher colour removal efficiency than real sample for all dyes. This may be due to the presence of dye auxiliaries, which interfere in real dye effluent. In this adsorption treatment CRBEL dye showed higher colour removal than other dyes (Fig. 10.1).

Colour removal in Fenton's oxidation method

Fenton's oxidation treatment was performed for all dyes under their optimized conditions for synthetic and real dye effluent (Table 10.2). Synthetic dye effluents showed higher colour removal efficiency than real sample for all dyes. This may be attributed to the presence of textile auxiliaries in real dye effluent, which hinder the colour removal. In this Fenton's oxidation study, CRBEL dye showed higher colour removal than other dyes (Fig. 10.2).
Colour removal in photochemical method

Various photo sources were employed in this study. Dye removal efficiency with different photo sources was studied for individual dyes and their results are presented below;

**CO2RB dye**

Colour removal in photochemical method for synthetic and real dye effluent was carried out using various photo sources (Table 10.3a). The colour removal efficiency was increased for the increase in energy of photo source in the bulb category. Tubes showed lower efficiency than bulbs. Among the various photo sources, UV illumination produced higher colour removal efficiency than others (Fig. 10.3a).

**CBBSLH dye**

Colour removal in photochemical method for synthetic and real dye effluents was carried out using different photo sources (Table 10.3b). The colour removal efficiency obtained for this dye is almost same that obtained for CO2RB dye (Fig. 10.3b).
CRBEL dye

Colour removal in photochemical method for synthetic and real dye effluent was carried out at using various photo sources (Table 10.3c). The colour removal efficiency obtained for this dye is almost same with that obtained for CO2RB and CBBSLH dyes (Fig. 10.3c). Similar trend is also observed for other dyes such as CY2GN (Table 10.3d and Fig. 10.3d) and CB2RX (Table 10.3e and Fig. 10.3e).

Colour removal in coagulation method.

The coagulation treatment was carried out for synthetic and real dye effluent using ferrous sulphate, ferric chloride and aluminium sulphate as coagulants (Table 10.4). Synthetic samples showed higher colour removal than real samples. Aluminium sulphate coagulant showed higher colour removal efficiency than other two (Fig. 10.4a and Fig. 10.4b).

Colour removal in electrochemical method

Colour removal in electrochemical method was carried out for synthetic and real dye effluents for all dyes (Table 10.5). It showed higher colour removal efficiency for real sample than synthetic sample (Fig. 10.5). This may be due to
the in situ generation of chlorine gas from the dye effluent that adds the treatment power.

**Summary of results**

When compared with various treatment methods in the colour removal for synthetic and real dye effluent samples, adsorption and Fenton’s oxidation methods showed improved colour removal efficiency with synthetic sample than with real sample (Table 10.6). On the contrary, photochemical, coagulation and electrochemical methods showed improved colour removal performance with real sample than synthetic sample.

In the treatment of dye effluent by electrochemical method, in addition to coagulation, the chloride present (from the salts used for dyeing) in dye effluent may help to generate oxidizing agents. Thus, electrochemical treatment for dye effluent can do both coagulation and oxidation reactions in a single bath to achieve much better performance. In the case of conventional coagulation with alum, aluminium is converted as aluminium hydroxide flocs and sulphate remains in the medium. In this method, only $\text{Al}^{3+}$ is consumed from the electrode and no possibility of sulphate content. These are the added advantage of the electrochemical treatment method.
Synthetic and real sample analysis

Table 10.1. Colour removal in adsorption treatment

<table>
<thead>
<tr>
<th>Dye</th>
<th>Colour removal (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Synthetic sample</td>
</tr>
<tr>
<td>CO2RB</td>
<td>89</td>
</tr>
<tr>
<td>CBBSLH</td>
<td>94</td>
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<tr>
<td>CRBEL</td>
<td>94</td>
</tr>
<tr>
<td>CY2GN</td>
<td>93</td>
</tr>
<tr>
<td>CB2RX</td>
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Table 10.2. Colour removal in Fenton’s oxidation treatment

<table>
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<th>Dye</th>
<th>Colour removal (%)</th>
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</thead>
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<td></td>
<td>Synthetic sample</td>
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<tr>
<td>CO2RB</td>
<td>95</td>
</tr>
<tr>
<td>CBBSLH</td>
<td>96</td>
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<tr>
<td>CRBEL</td>
<td>96</td>
</tr>
<tr>
<td>CY2GN</td>
<td>95</td>
</tr>
<tr>
<td>CB2RX</td>
<td>95</td>
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</tbody>
</table>

Table 10.3a. Colour removal in photochemical method for the dye CO2RB

<table>
<thead>
<tr>
<th>Photochemical Source</th>
<th>Colour removal (%)</th>
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</thead>
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<td></td>
<td>Synthetic sample</td>
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<td>15 W bulb</td>
<td>68</td>
</tr>
<tr>
<td>25 W bulb</td>
<td>75</td>
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<tr>
<td>40 W bulb</td>
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<td>60 W bulb</td>
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<tr>
<td>100W bulb</td>
<td>95</td>
</tr>
<tr>
<td>14W tube</td>
<td>91</td>
</tr>
<tr>
<td>40W tube</td>
<td>89</td>
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<tr>
<td>UV15W tube</td>
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<tr>
<td>Sun light</td>
<td>94</td>
</tr>
<tr>
<td>Dark</td>
<td>89</td>
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Table 10.3b. Colour removal in photochemical method for the dye CBBSLH

<table>
<thead>
<tr>
<th>Photochemical Source</th>
<th>Colour removal (%)</th>
<th>Synthetic sample</th>
<th>Real sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>15 W bulb</td>
<td>73</td>
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<tr>
<td>40 W bulb</td>
<td>88</td>
<td>84</td>
<td></td>
</tr>
<tr>
<td>60 W bulb</td>
<td>94</td>
<td>96</td>
<td></td>
</tr>
<tr>
<td>100 W bulb</td>
<td>98</td>
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</tr>
<tr>
<td>14 W tube</td>
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<td>90</td>
<td></td>
</tr>
<tr>
<td>40 W tube</td>
<td>90</td>
<td>88</td>
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</tr>
<tr>
<td>UV 15 W tube</td>
<td>100</td>
<td>95</td>
<td></td>
</tr>
<tr>
<td>Sun light</td>
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<td>Dark</td>
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Table 10.3c. Colour removal in photochemical method for the dye CRBEL

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<th>Photochemical Source</th>
<th>Colour removal (%)</th>
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<th>Real sample</th>
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<tbody>
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<td>15 W bulb</td>
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<td>25 W bulb</td>
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<td>100 W bulb</td>
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<td>40 W tube</td>
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<tr>
<td>UV 15 W tube</td>
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<td>91</td>
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<td>Sun light</td>
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<td>Dark</td>
<td>85</td>
<td>82</td>
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Table 10.3d. Colour removal in photochemical method for the dye CY2GN

<table>
<thead>
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<th>Photochemical Source</th>
<th>Colour removal (%)</th>
<th>Synthetic sample</th>
<th>Real sample</th>
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<tbody>
<tr>
<td>15 W bulb</td>
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<tr>
<td>25 W bulb</td>
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<td></td>
</tr>
<tr>
<td>40 W bulb</td>
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<td>79</td>
<td></td>
</tr>
<tr>
<td>60 W bulb</td>
<td>89</td>
<td>89</td>
<td></td>
</tr>
<tr>
<td>100 W bulb</td>
<td>94</td>
<td>90</td>
<td></td>
</tr>
<tr>
<td>14 W tube</td>
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<td>88</td>
<td></td>
</tr>
<tr>
<td>40 W tube</td>
<td>94</td>
<td>85</td>
<td></td>
</tr>
<tr>
<td>UV 15 W tube</td>
<td>100</td>
<td>90</td>
<td></td>
</tr>
<tr>
<td>Sun light</td>
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<td>Dark</td>
<td>76</td>
<td>70</td>
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Table 10.3e. Colour removal in photochemical method for the dye CB2RX

<table>
<thead>
<tr>
<th>Photochemical Source</th>
<th>Synthetic sample (%)</th>
<th>Real sample (%)</th>
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<tbody>
<tr>
<td>15 W bulb</td>
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<tr>
<td>25 W bulb</td>
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<tr>
<td>40 W bulb</td>
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</tr>
<tr>
<td>100 W bulb</td>
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<tr>
<td>14 W tube</td>
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<tr>
<td>Dark</td>
<td>81</td>
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Table 10.4. Colour removal in coagulation method.

<table>
<thead>
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<th>Coagulant</th>
<th>Synthetic sample (%)</th>
<th>Real sample (%)</th>
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<tbody>
<tr>
<td>CO2RB</td>
<td>Ferrous sulphate</td>
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<tr>
<td></td>
<td>Ferric chloride</td>
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<td>80</td>
</tr>
<tr>
<td></td>
<td>Aluminium sulphate</td>
<td>93</td>
<td>96</td>
</tr>
<tr>
<td>CBBSLH</td>
<td>Ferrous sulphate</td>
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<td>88</td>
</tr>
<tr>
<td></td>
<td>Ferric chloride</td>
<td>87</td>
<td>82</td>
</tr>
<tr>
<td></td>
<td>Aluminium sulphate</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>CRBEL</td>
<td>Ferrous sulphate</td>
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<td>88</td>
</tr>
<tr>
<td></td>
<td>Ferric chloride</td>
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<td>85</td>
</tr>
<tr>
<td></td>
<td>Aluminium sulphate</td>
<td>100</td>
<td>91</td>
</tr>
<tr>
<td>CY2GN</td>
<td>Ferrous sulphate</td>
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</tr>
<tr>
<td></td>
<td>Ferric chloride</td>
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<td>86</td>
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<tr>
<td></td>
<td>Aluminium sulphate</td>
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<td>96</td>
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<tr>
<td>CB2RX</td>
<td>Ferrous sulphate</td>
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<td>92</td>
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<tr>
<td></td>
<td>Ferric chloride</td>
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<td>83</td>
</tr>
<tr>
<td></td>
<td>Aluminium sulphate</td>
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<td>94</td>
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</table>

Table 10.5. Colour removal in electrochemical method.

<table>
<thead>
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<th>Dye</th>
<th>Colour removal (%)</th>
</tr>
</thead>
<tbody>
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<td></td>
<td>Synthetic sample</td>
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<td>CO2RB</td>
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<tr>
<td>CBBSLH</td>
<td>96</td>
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<td>CRBEL</td>
<td>87</td>
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<tr>
<td>CY2GN</td>
<td>88</td>
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<tr>
<td>CB2RX</td>
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Table 10.6. Colour removal efficiency of different methods– a comparison

<table>
<thead>
<tr>
<th>Treatment method</th>
<th>CO2RB</th>
<th>CBBSLH</th>
<th>CRBEL</th>
<th>CY2GN</th>
<th>CB2RX</th>
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<tbody>
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<td>S</td>
<td>R</td>
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<td>84</td>
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<td>40W bulb</td>
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<td>100W bulb</td>
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<td>14W tube</td>
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<td>91</td>
</tr>
</tbody>
</table>

(S=synthetic dye effluent and R=real dye effluent)
Fig. 10.1: Effect of adsorption for synthetic and real dye effluent

- **Synthetic**
- **Real**

Fig. 10.2: Effect of Fenton's oxidation for synthetic and real dye effluent

- **Synthetic**
- **Real**
Fig. 10.3a: Effect of different photo sources for CO2RB

![Graph showing the effect of different photo sources on CO2RB.]

Fig. 10.3b: Effect of different photo sources for CBBSLH

![Graph showing the effect of different photo sources on CBBSLH.]

**Fig. 10.3a**: Effect of different photo sources for CO2RB

**Fig. 10.3b**: Effect of different photo sources for CBBSLH
Fig. 10.3c: Effect of different photo sources for CRBEL

Fig. 10.3d: Effect of different photo sources for CY2GN
Fig. 10.3e: Effect of different photo sources for CB2RX

Fig. 10.4a: Effect of coagulants for synthetic dye solutions
Fig. 10.4b: Effect of coagulants for real dye effluents

Fig. 10.5: Effect of electrolysis for synthetic and real dye effluents