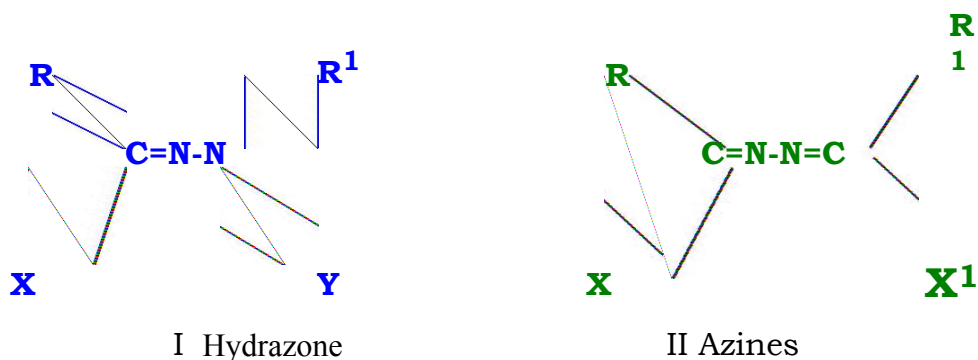


CHAPTER- 2

2.1 A brief review on hydrazones as spectrophotometric reagents

Hydrazones are azomethines characterized by the presence of the tri atomic grouping $>C=N-N<$. They are distinguished from other members of this class (imines, oximes etc.) by the presence of the two interlinked nitrogen atoms. The hydrazone group occurs in organic compounds of the types.



Where

- | | | |
|----------------------|---|--|
| R and R ¹ | = | H, Alkyl, Ar, RCO, Ht (Heterocyclic group) |
| Y | = | H, Alkyl, Ar, Ht, RCO |
| X and X ¹ | = | H, Alkyl, Ar, Ht, Halogens, OR, SR, CN, SO ₂ R,
NO ₂ , NHNR R', N = NR, COOR, CONR R' |

The detailed accounts of hydrazones preparations are given in a review[16] and Non analytical applications of Hydrazones are reported in the literature [17-25]

Jain and Singh [26] reviewed critically the applications of hydrazones as analytical reagents. Several articles also are available describing the formation of hydrazones and their applications.[27-38].

A list of various hydrazones [39-112] employed for the determination of different metal ions are presented in Table2-1.

Table 2.1. A list of hydrazones employed in the spectrophotometric determination of lead (II), Cadmium (II) Vanadium (V) and Copper (II)

Name of the Hydrazone	Metal ions	λ_{\max} (nm)	ϵ L mole ⁻¹ cm ⁻¹	M:L	Ref.
Pyridine-2-aldehyde-2-pyridylhydrazone (PAPH)	Cd(II) Cu (II)	405	-	1:1	39, 40
Quinoline-2-aldehyde-2-pyridyl-hydrazone (QAPH)	Cd (II) Cu (II)	517 512	4.1 X 10 ⁴ 5.8 x 10 ⁴	-	41, 42
Phenanthridine-6-carboxaldehyde-2-pyridylhydrazone (PDAPH)	Cd (II) Cu (II)	525 522	7.3 X 10 ⁴ 7.1 X 10 ⁴	-	41, 42
Phenanthridine-2-quinolyl-hydrazone (PDAQH)	Cd (II) Cu (II)	536	6.6 X 10 ⁴	-	41, 42
2-2'-dipyridyl-2-hydrazone (DPPH)	V(V) Cu (II)	-	-	-	43
o-Hydroxy benzaldehyde isonicotinoylhydrazone (or) 1-isonicotinoyl-2-salicylidene-hydrazine (INSH)	Cd (II)				44 45 46 47
4-Hydroxy benzaldehyde isonicotinoyl hydrazone	V (V)				48
Bis- (4-hydroxy benzoyl hydrazone) of glyoxal, methyl glyoxal and dimethyl glyoxal	Cd (II)			1:1	49 50
2,2'-Dipyridyl-2-quinolyl-hydrazone (DPQH)	V (V) Cu (II)	550 580 505	2.28 X 10 ⁴ 1.25 X 10 ⁴ 5.04 X 10 ⁴	1:1	51
2,2'-Dipyridyl-2-quinolyl-hydrazone (DPQH)	Cd (II)	511	8.78 X 10 ⁴	1:2	52
Pyridoxal-2-pyridylhydrazone	V (V)	430	1 X 10 ⁴	-	53
2- Thiophenalddehyde-2-quinolyl-hydrazone	V (V)	425	-	-	54
3- (Picolinoyl) benzene	V (V)	-	-	-	55

sulphuric acid-2hydroxy benzoyl hydrazone					
2,2'-Dipyridyl-ketone-2-quinolyl-hydrazone	V (V)	-	-	1:1	56
N-Cyanoacyl acetaldehyde hydrazone	V (V)	410	0.77×10^4	1:1	57
2-Hydroxy-1-naphthaldehyde guanylhydrazone	V (V)	405	0.77×10^4	1:1	58
Anthranilic acid resocylaldehydrazone	V (V)	410	1.35×10^4	-	59
2,6- Diacetylpyridinebis (benzoyl -hydrazone)	V (V)	335	2.74×10^4	-	60
2,6- Diacetylpyridine bis (2-hydroxy benzoyl hydrazone)	V (V)	336	2.77×10^4	-	60
Resacetophenone oxime salicylic acid hydrazone	V (V)	450	6×10^3	-	61
Di-2-Pyridylketone-2-pyridyl hydrazone	V (V)	545	1.4×10^4	-	62
2-Hydroxy-1-acetonaphthone salicylic acid hydrazone (HANSH)	V (IV)	410	1.22×10^4	1:2	63
	V (V)	410	1.4×10^4	1:2	63
2,4-Dihydroxy acetophenone benzoichydrazone	V (V)	380	1.3×10^4	1:1	64
	Cu (II)	400	1.1×10^4		
Ortho hydroxy acetophenone isonicotinoyl hydrazone	V (IV)	390	1.0×10^4	1:1	65
2,4-Dihydroxy benzophenone benzoic hydrazone	V (V)	390	2.0×10^4	1:1	66
2-Hydroxyacetophenone benzoyl hydrazone (HABH)	V (V)	375	8.93×10^3	-	67
2,4-Dihydroxy Benzaldehyde	V (V)	440	15×10^4	1:1	68
2'-Hydroxyacetophenone benzoyl hydrazone	V (II)	465	1.05×10^4	1:2	69
2,5-Dihydroxy acetophenone benzoichydrazone	V (V)	405	1.05×10^4	-	70
2,4-dimethoxybenzaldehyde-4-hydroxybenzylhydrazone	Cd (II)	387	3.68×10^4	1:1	71

2,4-dimethoxybenzaldehydeisonicotinoylhydrazone	Pb (II)	396	3.14×10^4	1:1	71
4-hydroxy-3,5-dimethoxybenzaldehyde-4-hydroxybenzylhydrazone	Pb (II)	386	2.66×10^4	1:1	72
	V (V)	392	2.26×10^4	1:1	
Benzyl- α -monoximeisonicotinoylhydrazone	Pb (II)	405	1.18×10^4	1:1	73
Diacetylmonoximebenzylhydrazone	Cd (II)	348	1.6×10^4	1:1	74
Diacetylmonoximeisonicotinoylhydrazone	Cd (II)	346	2.0×10^4	1:1	74
Benzyl- α -monoximeisonicotinoylhydrazone	Cd (II)	362	2.5×10^4	1:1	74
Diacetylmonoxime-4-hydroxybenzoylhydrazone	Pb (II)	440	1.71×10^4	1:1	75
2,4-dimethoxybenzaldehydeisonicotinoylhydrazone	V(V)	396	3.13×10^4	1:1	76
3-methoxysalicylaldehydeisonicotinoylhydrazone	V(V)	346	8.1×10^4	1:2	77
Cinnamaldehyde-4-hydroxybenzylhydrazone	Cd (II)	383	5.6×10^4	1:1	78
4-hydroxy-3,5-dimethoxybenzaldehyde-4-hydroxybenzylhydrazone	Cd (II)	400	4.81×10^4	1:1	79
Quinoline-2-aldehyde-2-quinolyl Hydrazone	Cu(II)	536	4.7×10^4	-	80,81
	Cu(II)	540	5.8×10^4		
Pyridine-2-aldehyde-1-Thionaphthyl Hydrazone	Cu(II)	480	6.35×10^3	1:2	82,83
2-Benzothiazolyl hydrazone-2-Thiophenaldehyde	Cu(II)	422	4.4×10^4	1:2	84
5-Methyl Furfural -2-benzothiazolyl hydrazone	Cu(II)	405-415	5.8×10^4	1:2	85
1-Naphthaldehyde-2-	Cu(II)	422	4.8×10^4	1:2	86

benzothiazolyl hydrazone					
Furfural-2-benzothiazolyl-hydrazone	Cu(II)	415	4.4×10^4	1:2	87
2-Hydroxy-1-naphthaldehyde-2-benzothiazolyl hydrazone	Cu(II)	426	2.2×10^4	1:1	88
6-Methyl Picolinaldehyde hydrazone	Cu(II)	425	7×10^3	..	89,90
Bicyclohexanone oxalyldi hydrazone	Cu(II)	600	1.6×10^4	..	91,92,93
Bis (Ethylacetoacetate) Oxalyl hydrazone	Cu(II)	585	1.39×10^4	1:2	94
Salicylaldehyde Hydrazone	Cu(II)	440	7.8×10^3	1:1	95
Benzil di-2-pyridyl hydrazone	Cu(II)	430	5.4×10^3	..	96
2,2-Pyridyldi-2-pyridyl hydrazone	Cu(II)	466	2.03×10^4	..	96
Pyridoin Phenyl hydrazone	Cu(II)	..	2.05×10^4	..	97
Benzilmono-(2-quinolyl)-hydrazone	Cu(II)	..	4×10^4	..	98
2-Thiophenaldehyde-2-benzothiazolyl hydrazone	Cu(II)	430	4.4×10^4	1:1	99
Di-2-Pyridylglyoxal-2-quinolyl hydrazone	Cu(II)	..	3.5×10^4	..	100
2-Hydroxy-1-acetonaphthone salicylic acid hydrazone	Cu(II)	400 410	1.1×10^4	1:1	101
2,4-Dihydroxy benzophenone benzoic hydrazone	Cu(II)	380	1.55×10^4	1:1	102
2,4-Dihydroxy benzaldehyde isonicotinoyl hydrazone	Cu(II)	430	1.65×10^4	1:1	103
Diacetylmonoxime benzoyl hydrazone	Cu(II)	346	1.36×10^4	1:1	104
Diacetylmonoxime isonicotinoyl hydrazone	Cu(II)	346	1.12×10^4	1:1	105
Benzil- α -monoxime isonicotinoyl hydrazone	Cu(II)	346	1.19×10^4	1:1	106
Diacetylmonoxime-4-	Cu(II)	396	1.8×10^4	1:1	107

hydroxy benzoyl hydrazone					
3,5-Dimethoxy-4-hydroxy benzaldehyde isonicotinoyl Hydrazone	Cu(II)	440	3.37×10^4	1:1	108
3-Methoxy salicylaldehyde 4-hydroxy benzoyl hydrazone	Cu(II)	390	1.17×10^4	1:1	109
4-Hydroxy,3,5-dimethoxy benzaldehyde-4-hydroxy benzoyl hydrazone	Cu(II)	383	3.41×10^4	1:1	110
Cinnamaldehyde-4-hydroxy benzoyl hydrazone	Cu(II)	375	2.77×10^4	1:1	110
2,4-Dimethoxy benzaldehyde-4-hydroxy benzoyl hydrazone	Cu(II)	384	3.8×10^4	1:1	111

A brief review on Spectrophotometric determination of Lead (II), Cadmium (II) Vanadium (V) and Copper (II) With different Analytical organic reagents are presented in **Table 2.2, 2.3 2.4 and 2.5**

Table. 2.2. A review on spectrophotometric determination of Cadmium (II) with different organic reagents

Reagent	λ_{\max} (nm)	pH/ medium	Molar Absorptivity (ϵ)($l \text{ mol}^{-1} \text{ cm}^{-1}$)	Ref. No
Ethyl violet(with iodide) (C.I.basic violet-4)	550	-	73.0×10^4	112
DAA [-phenyl-3-(4-phenylazophenyl)-triazene	525	10.0	17.7×10^4	113
2-(3,5-dibromo-2-pyridylazo)-5-diethylamino phenol	574	-	5.7×10^4	114
Ethyl violet (C.I. basic violet4)with KI	540	5.0	28.0×10^4	115
Brilliant green (C.I. basic green1)with KI	670	-	12.0×10^4	116
Ferron(sensitized by tetra decylpyridinium bromide)	390	4.5-5.5	3.2×10^4	117
1-(2-pyridylazo-2-naphthol) -	555	4.0-5.0	-	118
Cadian PB[1-(4-Bromophenyl)-3-(4-phenylazo phenyl)triazene]	515	10.5	45.0×10^4	119
Benzothioazo-2-ylozo-5-dimethylamino phenol	600	-	4.5×10^4	120
3[5-bromo-2-pyridylazo]-4,5-dimethyl phenol(in o-xylene)	590	-	3.8×10^4	120
Cadion-2B - 505 -	505		-	121
4-{4-(phenylazo)phenyl}trizen-1-	530	BR	21.1×10^4	122

yl}(Cadian AP)(in presence of tween-80)		buffers		
3,5 dibromo-4-[(4-phenylazophenyl trizeno]benzene sulphonamide	530		20.2 x 10 ⁴	123
Azo –5-pyrazolone dyes(C.I acid yellow54 C.I acid orange 74,and C.I.acid red186)	-	4.0-8.8	-	124
5,5',5''5'''-(21H,23H-porphine-5,10,15,20 tetrayl)tetratolune-O-sulphuric acid	440	10.8 borax -	76.0 x 10 ⁴	125
4-(2-pyridylazo)resorcinol	480	8.25	-	126
KI –butyl rhodamine B	600	-	114 x 10 ⁴	127
4,4'-bis(phenylazo)benzene diazoaminobenzene	526	Borate buffer	18 x 10 ⁴	128
Rhodamine 69 with (iodide)	575	-	8.9 x 10 ⁴	129
Hexamethyleneiminedithio Carbamate	435	1.5-6.0	0.50 x 10 ⁴	130
1-(2-Pyridylazo)2-naphthol	540	9.0	-	131
2,6-dibromo-4-nitrobenzene Diazoaminoazobenzene	500	8.0-12.0	15.2 x 10 ⁴	132
1-antipyrinal diazo amino2,4-dinitrobenzene(in presence of Triton X-100	540	10.2-12.0	15.2 x 10 ⁴	133
4-formyl benzene diazoaminoazo benzene(in presence of Triton X-100	525	9.5	13.3 x 10 ⁴	134
1,5-bis(3,4,5-trimethoxy phenyl)-3-mercapto formazans	-	-	-	135
1,5 bis (2-methoxy-4 –methyl phenyl) -3-mercapto formazans	-	-	-	135
2-chloro-4-nitrobenzeneazo amino azo benzene	505	7.8	15.7 x 10 ⁴	136
2,2'-dipyridyl ketone and some Diamines	-	-	-	137
p-acetylbenzenediazoamino azobenzene(in presence of Triton–X-100,SDBS)	-	-	-	138
4,4'-di[8-hydroxyquinolyl]azo-3,3'-dimethyl biphenyl(in presence of Tween-80)	530	7.8-9.0	7.2 x 10 ⁴	139
3-Bromo-4-(4-nitrophenyl diazoamino)azobenzene(in presence of Triton X-100)	495	Alkali medium	15.6 x 10 ⁴	140
3-Bromo-4-(2-bromo-4-nitrophenyl diazoamino)azobenzene (in presence of Triton X-100)	504	Alkali medium	15.0 x 10 ⁴	141

m-Chlorobenzene diazoaminoazobenzene (in presence of Triton X-100)	490	10.0	11.1 x 10 ⁴	142
2-Hydroxy-5-sulfo benzene Diazoaminoazobenzene	520	NH ₄ OH	18.8 x 10 ⁴	143
2-Pyridinediazoamino azobenzene (in presence of Triton X-100)	530	Ammonia buffer	19.2 x 10 ⁴	144
1-(2-benzothiazolyl)-3-(4-phenylazophenyl) triazene (in presence of Triton X-100)	502	9-11	14.0 x 10 ⁴	145
Cadion with triton-X 100	480	0.2-0.3	1.19 x 10 ⁴	146
Phenanthraquinonemonosemicarbazone (PQMS)	480	9.0	1.5 x 10 ⁴	147
1,3cyclohexanedionebisthiosemicarbazone monohydrochloride	515	-	1.21 x 10 ⁴	148
Glyoxaldithiosemicarbazone (GDS)	427	9.0-11.0	1.3 x 10 ⁴	149
1,2Naphthaquinone-2-thiosemicarbazone 4-sulfonic acid	520	6.0-7.0	1.9 x 10 ⁴	150
Bipyridylglyoxalbis (4-phenyl-3-thiosemicarbazone)	385	9.3	4.61 x 10 ⁴	151
2-hydroxy-4- <i>n</i> -butoxy-5-bromopropiophenone thiosemicarbazone (HBBrPT)	440	10.0	4035	152
5,7-Dibromo-8-hydroxy quinoline	396	-	5.3 x 10 ³	153
Di phenyl carbazone	493	7-10	-	154
5-methylfuran-2-carboxaldehyde thiosemicarbazone	360	5.0-7.0	3.6 x 10 ⁴	155
3- methylthiophene-2-carboxaldehyde thiosemicarbazone (3-MTAT)	360	6.0	4 x 10 ⁴	156
1-ethyl-6-fluoro-4-oxo-7-piperazin-1-yl-1 <i>H</i> -quinoline-3-carboxylic acid (Norfloxacin)	360	6.0	3.7 x 10 ⁴	157

Table 2.3: A review on spectrophotometric determination of Lead(II) with different organic reagents

Reagent	λ_{\max} (nm)	pH/ medium	Molar absorptivity (ϵ) (L. mol ⁻¹ cm ⁻¹) X10 ⁴	Ref. No.
Nitrochrome-pyrazole	580	-	-	158
Didecylamino ethyl-B-tridecyl ammonium iodide	285 (or) 420	-	-	159
4-(2-Pyridylazo) resorcinol	515	-	3.107	160
1,10-Phenanthroline (or) 4,7-diphenyl-1,10-Phenanthroline and bromophenol blue	612 (or) 618	6.0	-	161
2-Acetylpyridine salicyloylhydrazole	380	-	1.93	162
Dicyclohexyl 18-crown-6-and dithione	514	-	-	163
Triethylenetetraamino-hexakis methylene phosphonic acid	-	6.5	-	164
Monothiotheonyltrifluoroacetone[1,1,1-trifluoro-4-(2-thienyl-4-thioxo butan-2-one)]	384	10.0	29.7	165
5,10,15,20-tetrakis(hydroxyl phenyl) porphine(2-hydroxyphenyl,(3-hydroxyphenyl,3,4-dihydroxyphenyl)	467 467 472	9.9-10.7 9.6-10.3 10.3-11.8	21.1 26 10.8	166
5,10,15,15,20-Tetrakis[4-(trimethylamino)phenyl]-porphine	463	9.5	30.0	167
Pyrogallol red and hexadecyltrimethylammonium bromide	610	6.5	2.1	168
KI-butyl rhodamine B (presence of acacia-triton-X-100)	605	-	62.0	169
5,5,5,5-(21H,23H porphine-5,10,15,20-tetrayl) tetratoluene-O-sulphonic acid	464	10.5	28.2	170

O-Nitrophenylfluorene	-	6.0-6.6	-	171
Xylenol orange	-	OAc buffer 5.4-5.7	-	172
Sodium N,N-diethyl dithiocarbamate	435	-	1.3	173
2-(2-thiazolylazo)-p-cresol	650	9.0-10.0	2.07	174
1-(2-pyridylazo)-2-naphthol	550	-	2.11	175
N-hydroxy-N ¹ .N ² -diphenyl benzamidine in CHCl ₃ with 4-(2- pyridylazo)resorcinol	525	-	5.18	176
Hexamethelene imine di thiocarbamate	435	3.0-5.0	0.502	177
Tetra ethylammonium-benzene dithiocarboxylate	-	-	-	178
Meso-tetrakis(4- bromophenyl)porphyrin(presence of Tween-80)	468	8.5-9.5	28.7	179
Diaza-18-crown-6 and rose Bengal	562	11.0	6.0	180
4-(2-thiazolylazo)-6-formyl resorcinol	565	7.5-8.0	1.62	181
Dibromo-p-methyl- methylsulfonazo(benzoylacetone) meso-stilbenediimine	462	Acidic medium	8.28	182

Table 2.4. A review on spectrophotometric determination of Vanadium(V) with different organic reagents

Reagent	$\lambda_{\max}(\text{nm})$	pH	Molar absorptivity (ϵ)(L.mol ⁻¹ .cm ⁻¹)	Ref.
Acetophenone 2', 4'-dihydroxysemicarbazone [A24DHS]	380	8.2	3.89×10^3	183
Naphthalene -1, 5 -diamine	531	4 - 5.5	3.0×10^3	184
2-hydroxy-3-methoxy benzaldehyde thiosemicarbazone (HMBATC)	395	4 - 7	2.49×10^4	185
2,3,4-trihydroxyacetophenone phenylhydrazone	390	2.8	1.999×10^5	186
Azure B.	636	2M HCl	4.33×10^4	187
4-(2-pyridylazo)resorcinol (PAR)	559	-	1.95×10^5	188
3,5-dinitrocatechol (DNC) and Brilliant Green	630	H ₂ SO ₄ -HF	1.7×10^5	189
5,5'-dithiodisalicylhydroxamic acid (DTDSHA)	550	5.0	7.34×10^3	190
Orthoamino phenol (OAP)	405	0.1M H ₂ SO ₄	6.7×10^5	191
2,3-dichloro-6-(2,7-dihydroxy-1-naphthylazo) quinoxaline (DCDHNAQ)	573	3.3	2.45×10^5	192
1,5-diphenylcarbohydrazide (DPCH)	531	4.0-5.5	4.23×10^4	193
leucocrystal violet (LCV)	590	-	6.78×10^4	194
1-(2-quinolylazo)-2,4,5-trihydroxybenzene(QATB)	590	6.0-7.5	2.55×10^4	195
4-(2-pyridylazo)-resorcinol and H ₂ O ₂	542	-	1.85×10^4	196
4-(2-Pyridylazo)-resorcinol and Tetrazolium Violet	555	4.5-5.5	3.05×10^4	197
5-bromo salicylaldehyde isonicotinoyl hydrazone (5-BrSAINH)	400	1-5	1.25×10^4	198
2,4-Dihydroxy acetophenone isonicotinoylhydrazone	400	1-7	8.9×10^3	199

4-(4'-Methyl-2'-thiazolylazo)-2-methyl-resorcinol	560	-	2.50×10^4	200
Prochlorperazine bismethanesulphonate	529	3.6-6M H ₃ PO ₄	1.24×10^4	201
3,3'-Dimethylnaphthidinedisulphonic acid	555	8-13M H ₃ PO ₄	1.94×10^4	202
4-(2-pyridylazo)resorcinol (PAR)	585	4.6-5.1	1.1×10^5	203
with <i>N-p</i> -aminophenyl-2-thionylacrylohydroxamic acid and 3-(<i>o</i> -carboxyphenyl)-1-phenyltriazine- <i>N</i> -oxide	455	3.5-7.5 M HCl	1.55×10^4	204
2,2'-iminodibenzoic acid	610	H ₂ SO ₄	1.2×10^4	205
trihydroxamic acid, desferroxamine B	480	-	3.15×10^3	206
5,7-dibromo-8-hydroxyquinoline (DBHQ)	400	0.00015 -0.016 mol ⁻¹ H ₂ SO ₄	6.1×10^3	207

Table 2.5: A review on spectrophotometric determination of Copper (II) with different organic reagents.

Reagent	λ_{\max} (nm)	pH	Molar absorptivity (ϵ) (L.mol ⁻¹ .cm ⁻¹)	Ref.
{5M,3H-BR} 5- α -Methyl-3hydroxy benzylidene}rhodamine	430	5.5	0.6027	208
5-Bromosalicylaldehydethiosemicarbazone	390	-	1.08	209
5- α -methyl-3-hydroxybenzylidene}rhodamine	430	-	-	210
4-Vanillideneamino-3-methyl-5-mercapto-1,2,4-triazole	430	8.5	9.929	211
Isonitrosopropiophenonethiosemicarbazone	390	-	-	212
Azure – B	644	2.0-6.0	1.760	213
Alizarin Red-S	510	-	-	214
Phosphoryl derivative of p-tert-	373	8.3	-	215

butylthiacalix(4)arene				
8-Methoxy-2-chloroquinoline-3-carbaldehyde thiosemicarbazone	410	5.0	2.67	216
N-(2,5-Dimethylphenyl)-p-toluimidoyl Phenyl hydrazine	410	7.5-10.0	4.0	217
5-[4'-3'-Pyridiniumpropoxy)phenyl]-10,15,20-Triphenyl porphyrin bromide	413-	-	2.9	218
2-Acetyl1,4-phenyl-3-thiosemicarbazone	385	3.0-6.0	2.92	219
1,4-Dihydrazonephthalazine	380	2.0-6.0	2.2	220
1-Phenyl,1,2-propanedione-2-oximethiosemicarbazone	465	5.0	5.56	221
Dipyridylglyoxal dithiosemicarbazone	390	6-10	0.95x10 ⁴	222
Furoin Thiosemicarbazone	355	3-0	1.45x10 ⁴	223
Glyoxal dithiosemicarbazone	485	3-10	0.67x10 ⁴	224
β- Ionone thiosemicarbazone	380	4-7	-	225
1,2-Naphthoquinone-2-Thiosemi Carbazone-4-sulfonica acid	550	3-7	1.33x10 ⁴	226
Phenanthraquinone monothiosemi carbazone	540	5	1.16x10 ⁴	227
2-(3 ¹ – Sulphobenzoyl) pyridine thio semicarbazones	390	-	1.03x10 ⁴	228
Biacetyl bis(4-phenyl-3-thiosemi Carbazone	485	-	1.27x10 ⁴	229
2-Methyl-1,3-cyclohexanedione bis (4-phenyl-3-Thiosemicarbazone	480	1.0-2.0	-	230, 231
Benzil-α-monoxime Thiosemicarbazone	355	4-7	2.20x10 ⁴	232
Diacetylmonoxime -4 -phenyl-3-Thiosemi Carbazone	355	2-6	0.56x10 ⁴	232
2-Acetylthiophene-4-phenyl-3-Thiosemi Carbazone	385	3-6	2.9x10 ⁴	233
2-Acetylthiophene Thiosemi Carbazone	370	6-8	1.83x10 ⁴	234
4-Hydroxybenzaldehyde Thiosemi Carbazone	355	6-0	-	235
2-Hydroxy-3,5-dimethoxybenzaldehyde	397	-	3.06x10 ⁴	236

Thiosemi Carbazone-Cu(II)				
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