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**REF 2420722**     *25 Tubes DCO 200-15 000 mg/L DCO*

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*Version Janvier 2024*

*Les tests à cuves contiennent des quantités de réactifs parfaitement dosées. Ceci permet donc d'éviter un surplus de produits chimiques et d'augmenter la sécurité du travail.*

*Verre optique spécial des tubes     Tube de 16mm de diamètre*

*Dimension colis en mm     150 x 150 x 139 mm*

*Poids colis avec emballage     535g*

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***Utilisables sur les appareils Photomètre Lovibond***

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MD 100 DCO, tests à cuve  
MD 110 DCO  
MD 200 DCO, tests à cuve  
MD 600  
MD 610  
MD 640  
MultiDirect  
MultiDirect, avec pile  
MultiDirect, sans pile  
Poste de mesure DCO MD 100  
Poste de mesure DCO MD 110  
Poste de mesure DCO MD 200  
Poste de mesure DCO MD 600  
Poste de mesure DCO MD 610  
Poste de mesure des eaux usées MD 600  
Poste de mesure des eaux usées MD 610  
Postes de mesure DCO  
Série de photomètres MD 600

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***Compatibilité Hach***

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*Equivalent REF HACH 2415951 (Europe) 2415925 (US) (attention tube 16mm et non 13mm)*



## ***Traitement des déchets (tubes après utilisation)***

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### *Exemple de prestataires*

- *Clikeco*  
*Andréa Saldanha, +33(0)7 50 58 66 82, andrea.saldanha@clikeco.com*

*L'avantage, c'est surtout un service package complet, la société propose un contenant dédié pour chaque déchet (selon volume et taille estimé du déchet), avec une reprise vide contre plein, transport ADR, et documentation fournie via Track Déchet (plateforme de l'état concernant le suivi des déchets). La solution est bien adaptée à des petites structures (type labo), mais pas forcément pour des gros volumes.*

- *Nordéchets*  
*Fabrice Muzotte, +33 6 95 02 61 75 /f.muzotte@nordechets.com*

*Nordéchets est une société proposant à priori des prestations classiques. Ils ont un centre de traitement sur Pithiviers (45). Le cout est potentiellement moins élevé que les autres prestataires, mais il faudra rajouter le transport ADR. La prestation peut être intéressante pour de gros volume, Nordéchet pouvant proposer des contenants et des reprises ADR sur site.*

- *SAS Service Action Santé*  
*Olivier Delis, 01 64 97 48 65, contact.client@sa-sante.fr*

*Zone d'intervention pour la collecte des déchets médicaux - Service Action Santé (serviceactionsante.fr). Prestataire qui couvre une partie seulement du secteur national, mais potentiellement compétitif pour une récupération en région parisienne.*

- *RECYDIS (groupe PAPREC)*  
*camille.BARBIER@paprec.com*  
*Fixe : 01.55.81.26.31 / Portable : 07.88.93.27.36*

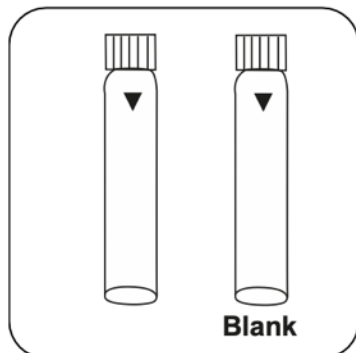
*Recydis Paprec Group propose un service similaire à Clikeco. La différence entre ces deux prestataires se fera sans doute davantage dans le détail de leur prestation.*

*Recydis : Collecte et traite vos déchets dangereux*

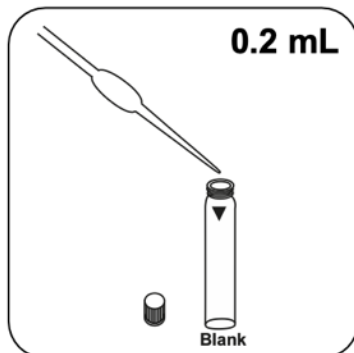
## Méthode 132

### Réalisation de la quantification DCO HR avec test à cuve Vario

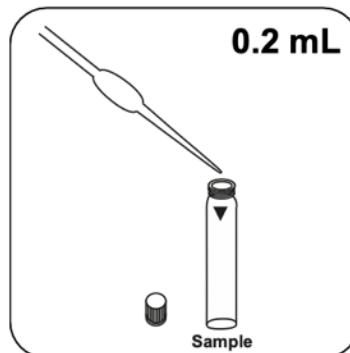
Sélectionnez la méthode sur l'appareil.



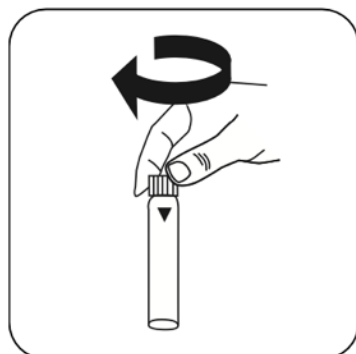
Préparez deux **cuvettes de réactif**. L'une des deux cuvettes sera la cuvette du blanc. Étiquetez-la.



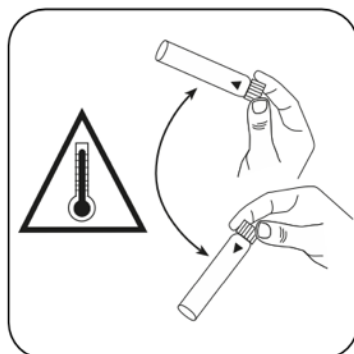
Versez **0.2 mL d'eau déminéralisée** dans la cuvette du blanc.



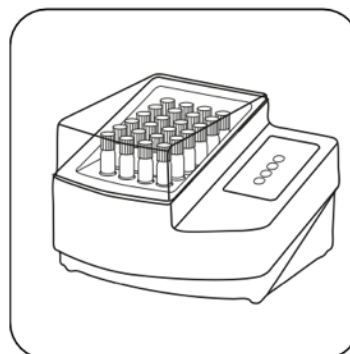
Versez **0.2 mL d'échantillon** dans la cuvette réservée à l'échantillon.



Fermez la(les) cuvette(s).



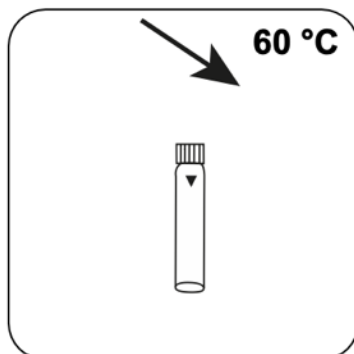
Mélangez soigneusement le contenu en mettant prudemment le tube à l'envers puis à l'endroit. **Attention : Développement de chaleur !**



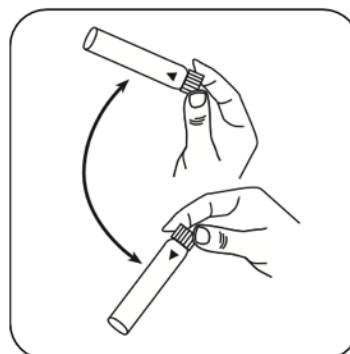
Fractionnez la(les) cuvette(s) dans un thermoréacteur préchauffé pendant **120 minutes à 150 °C**.



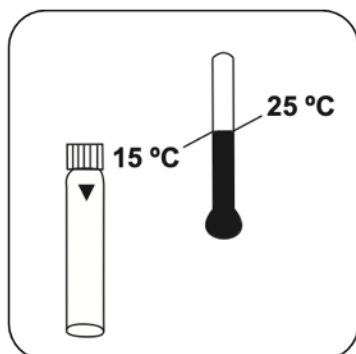
Retirez la cuvette du thermoréacteur. (**Attention : la cuvette est très chaude !**)



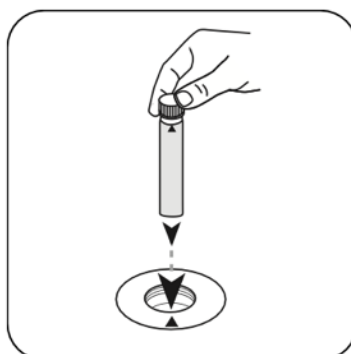
Laissez la(les) cuvette(s) refroidir à env. 60 °C.



Mélangez le contenu en mettant le tube plusieurs fois à l'envers puis à l'endroit.



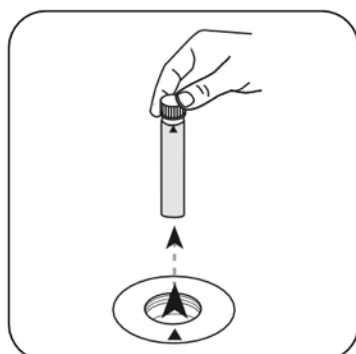
Laissez d'abord refroidir la cuvette à température ambiante puis effectuez les mesures.



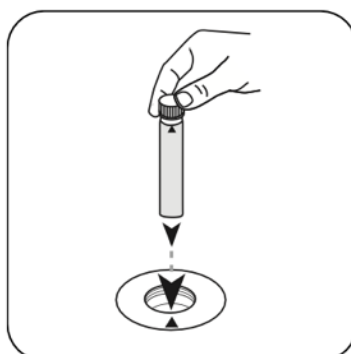
Placez la **cuvette du blanc** dans la chambre de mesure. Attention à la positionner correctement.

# Zero

Appuyez sur la touche **ZERO**.



Retirez la **cuvette** de la chambre de mesure.



Placez la **cuvette réservée à l'échantillon** dans la chambre de mesure. Attention à la positionner correctement.

# Test

Appuyez sur la touche **TEST** (XD: **START**).

Le résultat s'affiche à l'écran en g/L DCO (XD: mg/L DCO).

## Méthode chimique

Dichromate / H<sub>2</sub>SO<sub>4</sub>

## Appendice

### Fonction de calibrage pour les photomètres de tiers

$$\text{Conc.} = a + b \cdot \text{Abs} + c \cdot \text{Abs}^2 + d \cdot \text{Abs}^3 + e \cdot \text{Abs}^4 + f \cdot \text{Abs}^5$$

	<b>∅ 16 mm</b>
a	-3.10235 • 10 <sup>+2</sup>
b	2.1173 • 10 <sup>+4</sup>
c	1.64139 • 10 <sup>+2</sup>
d	
e	
f	

## Interférences

### Interférences persistantes

- Exceptionnellement, les constituants pour lesquels la capacité oxydante du réactif ne suffit pas, peuvent entraîner une baisse des résultats.

### Interférences exclues

- Pour empêcher les erreurs de mesure par des éléments en suspension, il est important de placer soigneusement les cuvettes dans la chambre de mesure. En effet, la méthode cause la formation d'un précipité sur le fond des cuvettes.
- Les parois extérieures des cuvettes doivent être sèches et propres avant de procéder à l'analyse. La présence de traces de doigt ou de gouttes d'eau sur la cuvette entraînent des mesures erronées.
- Dans la version standard, le chlorure interfère à partir d'une concentration de 10000 mg/L. Dans la version sans mercure, la perturbation dépend de la concentration de chlorure et de la DCO. Des concentrations à partir de 100 mg/L de chlorure peuvent ici entraîner des perturbations importantes. Pour éliminer les concentrations élevées de chlorure dans les échantillons DCO, voir la méthode M130 COD LR TT.



## WATER KITS SUPPLY

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www.water-kits.fr

## Méthode Validation

<b>Limite de détection</b>	112.81 mg/L
<b>Limite de détermination</b>	338.43 mg/L
<b>Fin de la gamme de mesure</b>	15 g/L
<b>Sensibilité</b>	21,164 mg/L / Abs
<b>Intervalle de confiance</b>	70.48 mg/L
<b>Déviat ion standard</b>	27.84 mg/L
<b>Coefficient de variation</b>	0.37 %

### Conformité

ISO 15705:2002

### Selon

ISO 15705:2002

<sup>b)</sup>Réacteur nécessaire pour DCO (150 °C), COT (120 °C), chrome total, phosphate total, azote total, (100 °C)



## **Comparaison avec tube Hach**

### **INSTITUT FRESENIUS**

## **Comparability Study between the LOVIBOND COD „vario“ cuvette test and the Hach™ COD cuvette test**

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### **Introduction and objectives of this study**

The chemical oxygen demand (COD) of water is defined as the volume-related mass of oxygen, which is equivalent to the mass of sodium dichromate digested under given operational conditions to oxidize the oxidizable compounds present in the water.

The purpose of the present study is to compare the LOVIBOND COD vario cuvette test with the corresponding Hach™ cuvette test as well as with the reference method (DIN 38409). The LOVIBOND COD vario cuvette test may be used with LOVIBOND photometers as well as with Hach\* photometers. The study was sponsored by LOVIBOND.

### **Methods employed, reagents, and apparatus**

The following LOVIBOND products were employed to perform the cuvette tests:

- 1) Cuvette test COD Vario 0 - 150 mg/l (Cat. No. 420720)
- 2) Cuvette test COD Vario 0 - 1500 mg/l (Cat. No. 420721)
- 3) Cuvette test COD Vario 0 - 15000 mg/l (Cat. No. 420722)



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The following Hach™ products have been used:

- 1) Cuvette test COD 0 - 150 mg/l (No. 21258)
- 2) Cuvette test COD 0 - 1500 mg/l (No. 21259)
- 3) Cuvette test COD 0 - 15000 mg/l (No. 24159)

A Hach™ DR/2010 Photometer was used for the photometric evaluation of both cuvette tests.

The cuvette tests were performed according to the user's manual issued by the instrument's manufacturer and the instructions covering the photometer which was used.

The standard DIN 38402 – 71 [3] was used as a reference for the comparison between methods. Because the stringent restrictions of this standard often make it difficult or impossible to determine comparability between different methods [ 1 ], Part II of this present study is based on simpler, commonly accepted comparison tests.

Sodium hydrogenphthalate solutions in water were used as standards for the analytical methods.

The actual effluent samples which were examined were of municipal and industrial effluents (ca. 50% each) taken at random upstream and downstream of treatment plants. The sewage samples were homogenized prior to analysis by an Ultra-Turrax T 50.

### **Part I**

#### **Proof of comparability of the Lovibond and Hach™ analytical methods for the determination of COD in effluents, to DIN 38 402-71.**

##### **I.1 Comparison of distribution, using methods capable of calibration in matrix-free solutions**

Single measurements of calibration standards were used to prove the comparability of distribution. Identification of the limits of determination and quantification was performed in accordance with the calibration straight method set out in DIN 32645.



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 Table 1: Comparison of distribution (Variance F-Test);  
 Detection and quantification limits to DIN 32 645

$$F(99\%;f_1,f_2) = 6.03 \quad f_1 = f_2 = N-2$$

Measurement range COD mg/L	V <sub>x0</sub>	PG	Signif. Difference	N	LOD mg/l	LOQ mg/l
0-150 Lovibond	1.46		No	10	4.2	14.2
0-150 Hach™	1.89	1.29	No	10	5.5	18.2
0-1500 Lovibond	1.15		No	10	33	113
0-1500 Hach™	0.96	1.20	No	10	28	94
0-15000 Lovibond	0.88		No	10	254	864
0-15000 Hach™	1.08	1.23	No	10	312	1055

**Key :**

F(99%;f <sub>1</sub> ,f <sub>2</sub> )	Table value of F-distribution
f	Number of degrees of freedom
V <sub>x0</sub>	Method variation coefficient
PG	test statistic; if PG is less than F then no significant difference
N	Number of measurements
LOD	Limit of detection
LOQ	Limit of quantification

**Assessment:**

- The comparison of distribution shows no significant differences between the two methods.
- The limits of detection and quantification are comparable for both methods over all three measurement ranges tested (see part II, table 5).

**The equality of both analytical methods is demonstrated with regard to distribution, limit of detection, and limit of quantification.**

### I.2 Proof of equality of analytical results of real samples by means of a mean value t-test.

 Table 2: Comparison of real samples by means of a mean value t-test.  
 Reference method: Hach™

Measurement range 0 – 150 mg/l	Sample 1		Sample 2	
	Lovibond	Hach™	Lovibond	Hach™
N	7	7	7	7
Mean value	<b>9.9</b>	<b>10.1</b>	<b>85</b>	<b>84</b>
Standard deviation	1.68	1.57	2.98	3.15
relative	17.00	15.51	3.50	3.73
Outlier	0	0	0	0
F-test-significant		No		No
MV-t-test-significant		No		No

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Measurement range 0 – 1500 mg/l	Sample 3		Sample 4	
	Lovibond	Hach™	Lovibond	Hach™
N	6	6	6	6
Mean value	<b>288</b>	<b>291</b>	<b>1.215</b>	<b>1.220</b>
Standard deviation	7.03	8.36	18.20	16.46
relative	2.44	2.87	1.50	1.35
Outlier	0	0	0	0
F-test-significant		No		No
MV-t-test-significant		No		No

Measurement range 0 – 15000 mg/l l	Sample 5		Sample 6	
	Lovibond	Hach™	Lovibond	Hach™
N	8	8	6	6
Mean value	<b>3293</b>	<b>3301</b>	<b>13780</b>	<b>13973</b>
Standard deviation	96.62	97.02	139.86	233.30
relative	2.93	2.94	1.01	1.67
Outlier	0	0	0	0
F-test-significant		No		No
MV-t-test-significant		No		No

### Assessment:

1. Outlier test  
Both methods show no outliers for all six samples.
2. Test of homogeneity of variances  
All samples show no statistic significant differences of variances.
3. Mean value t-test  
Statistically significant differences in mean values were detected in none of the six samples.

**The equality of the methods of Lovibond and Hach™ for real samples is demonstrated, using the mean value t-test.**

### I.3 Proof of the comparability of analytical results of real samples by means of orthogonal regression

Mean values of double determinations of the real samples were used in order to compare the methods by means of a orthogonal regression.

DIN 38 402 requires the analysis of at least 30 real samples, equally distributed as much as possible over the concentration range under examination. In addition, the highest and the lowest result must not deviate by more than a factor of 100. In practice it is difficult and sometimes impossible to achieve these two requirements with an acceptable degree of effort [1]. This study therefore focuses on demonstrating comparability of the two methods under examination, by restricting consideration to results greater than the limit of quantification (LOQ = 15 mg/l) up to 1500 mg/l COD.

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During the test period there was a lack of samples with COD values between 4000 and 15000 mg/l.

### I.3.1 Equality of the three measurement ranges

The three measurement ranges were first tested for systematic deviations by means of an orthogonal regression<sup>1</sup>. The results are shown in table 3. There are no hints for systematic deviations. The results for each individual measurement range are presented in the graphs 1 to 3.

Table 3 Orthogonal regression of real samples per measurement range

Measurement range 0 - 150 mg/l	Lovibond/Hach™
Slope	1.030
Intercept	-3.7
N	13
Outlier	1
<b>prop.-syst. Deviation</b>	No
<b>const.-syst. Deviation</b>	No

Measurement range 0 - 1500 mg/l	Lovibond/Hach™
Slope	0.999
Intercept	-3.7
N	25
Outlier	0
<b>prop.-syst. Deviation</b>	No
<b>const.-syst. Deviation</b>	No

Measurement range 0 - 15000 mg/l	Lovibond/Hach™
Slope	1.005
Intercept	-3.0
N	11
Outlier	1
<b>prop.-syst. Deviation</b>	No
<b>const.-syst. Deviation</b>	No

### I.3.2 Comparison of methods, carrying out COD determination on real samples

The result range of 0 – 1500 mg/l COD was selected in order to prove the comparability of the two methods to DIN 38 402. This range consists of 38 data points.

Cuvettes of the measurement ranges 0 – 150 mg/l and 0 – 1500 mg/l were employed to generate the measurement values used for the calculation. The distribution of the results is shown in Figs. 1 and 2. Four data points were excluded from the calculation

<sup>1</sup> This test does not exactly comply with the requirements of the DIN 38 402 due to the small number of samples in the three measurement ranges. The purpose here is merely to check whether there are any signs of deviations in the individual measurement ranges.

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because the results were below the limit of quantification of approximately 15 mg/l (see table 1). The result of the comparison study using real samples is shown in table 4:

Table 4 Orthogonal regression of real samples

Samples 15 – 1500 mg/l	Lovibond/Hach™
Slope	0.997
Intercept	-2.3
N	34
Outlier	1
<b>const.-syst. Deviation</b>	No
<b>prop.-syst. Deviation</b>	No

### Graphical representation of the results from real samples

Figure 1  
Real samples 0 - 150 mg/l

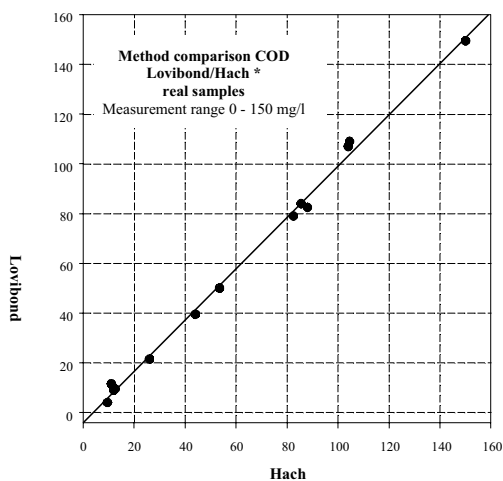
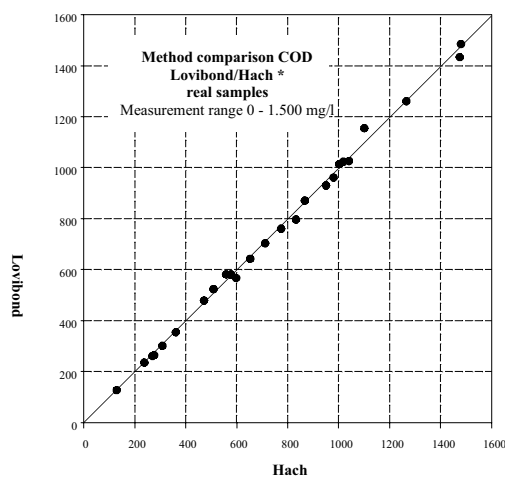
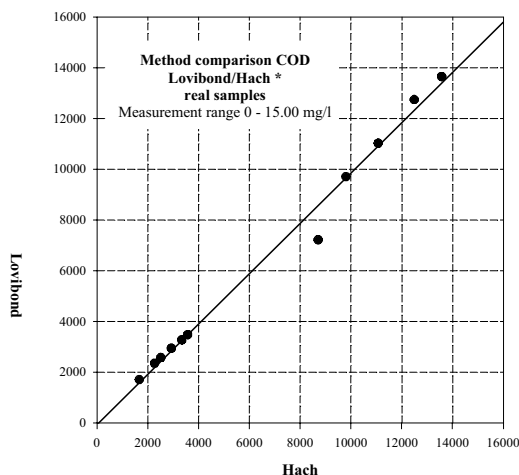


Figure 2  
Real samples 0 - 1500 mg/l



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Figure 3  
Real samples 0 - 15000 mg/l



**Assessment:**

1. One outlier for the data points was determined
2. The direct comparison between Lovibond/Hach™ revealed no significant proportional-systematic deviation
3. The direct comparison between Lovibond/Hach™ also revealed no significant constant-systematic deviation

**The comparison between Lovibond and Hach™ demonstrates equality for both methods according to DIN 38 402-71 for values in the measurement ranges 0 - 150 and 0 - 1500 mg/l.**

**Comparability for values between 1500 - 15000 mg/l is highly probable but could not be demonstrated statistically due to a lack of appropriate samples (see Figure 3) .**

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### Graphical representation of the calibration curves

Figure 4  
 Calibration 0 - 150 mg/l

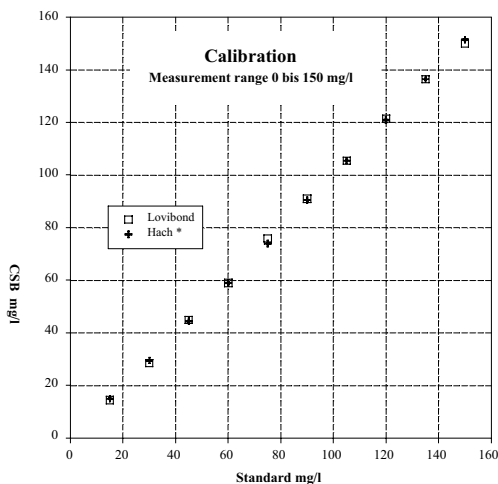


Figure 5  
 Calibration 0 – 1.500 mg/l

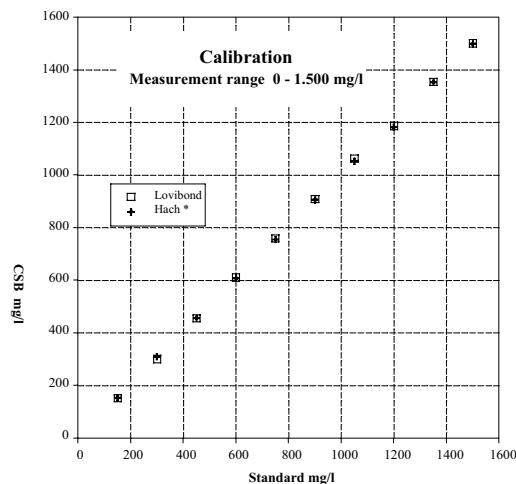
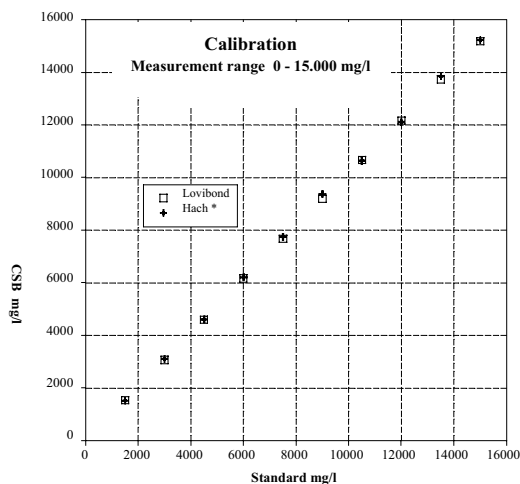


Figure 6  
 Calibration 0 – 15.000 mg/l



**The calibrations of the methods under examination agreed extremely well for all measurement ranges.**

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### Part II

#### Comparison of Lovibond and Hach™ calibrations with DIN 38409 H41

Figs. 4 to 6 show that the calibrations of the tested methods are in excellent agreement. [This section deals with the comparison of the two cuvette methods using the DIN method.](#) Table 5 shows the statistic evaluation for all three methods at the individual measurement ranges. The calculations are based on single determinations.

Table 5

 Significance level  $P = 99\%$ ;  $k = 3$ 

Method	Lovibond	Hach™	DIN
Measurement range	0 - 150 mg/l		
N	10	10	10
Intercept	-0.600	-0.933	-1.133
Slope	1.011	1.013	1.,014
Remain. std. dev.	1.22	1.58	0.71
<b>V<sub>x0</sub></b>	<b>1.46</b>	<b>1.89</b>	<b>0.63</b>
Correlation coeff.	0.9997	0.9995	0.9999
<b>x<sub>NG</sub></b>	<b>4..2</b>	<b>5..5</b>	<b>2.4</b>
<b>x<sub>BG</sub></b>	<b>14.2</b>	<b>18.2</b>	<b>8.4</b>
CI LOQ lower **)	9.6	12.3	5.7
CI LOQ upper	27.2	34.9	16.0

\*\*) CI LOQ = Confidence interval of the limit of quantification in accordance with DIN 32 645

Measurement range	0 – 1.500 mg/l		
N	10	10	10
Intercept	6.87	13.7	17.6
Slope	0.995	0.985	0.993
Remain. std. dev.	9.46	7.82	6.61
<b>V<sub>x0</sub></b>	<b>1.15</b>	<b>0.96</b>	<b>0.60</b>
Correlation coeff.	0.9998	0.9999	0.9999
<b>x<sub>NG</sub></b>	<b>33</b>	<b>28</b>	<b>23</b>
<b>x<sub>BG</sub></b>	<b>113</b>	<b>94</b>	<b>80</b>
CI LOQ lower **)	77	64	54
CI LOQ upper	216	181	153

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Method	Lovibond	Hach™	DIN
Measurement range	0 – 15.000 mg/l		
N	10	10	10
Intercept	127	48.0	16.7
Slope	0.999	1.016	0.989
Remain. std. dev.	72.5	90.34	50.57
$V_{xo}$	<b>0.88</b>	<b>1.08</b>	<b>0.62</b>
Correlation coeff.	0.9999	0.9998	0.9999
$x_{NG}$	<b>254</b>	<b>312</b>	<b>179</b>
$x_{BG}$	<b>864</b>	<b>1055</b>	<b>614</b>
CI LOQ lower **)	588	717	417
CI LOQ upper	1659	2025	1178

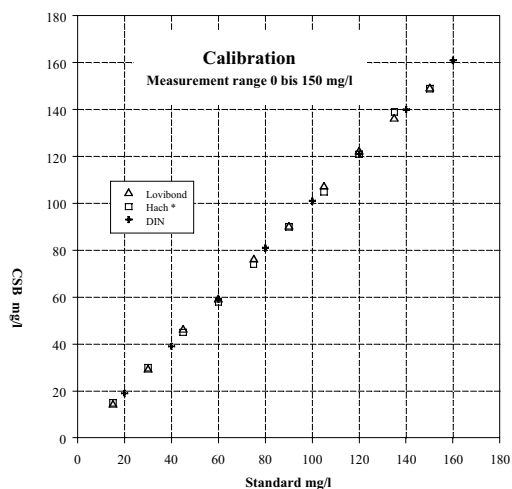
Table 5 shows that the slopes of the calibration curves are close to the theoretical nominal value of 1 in all measurement ranges. The slope values are between 0.985 and 1.016. The variance coefficient of the methods  $V_{xo}$  is small and has values between 0,60% and 1,89%. All correlation coefficients are higher than 0,9995.

The limits of detection and quantification are comparable. The confidence intervals (CI LOQ) overlap for the individual measurement ranges (except for measurement range 0 - 150 and 0 - 15000 mg/l for the comparison between Hach™ and DIN).

**The calibrations of the methods examined are comparable with regard to distribution, sensitivity, and limits of quantification and detection.**

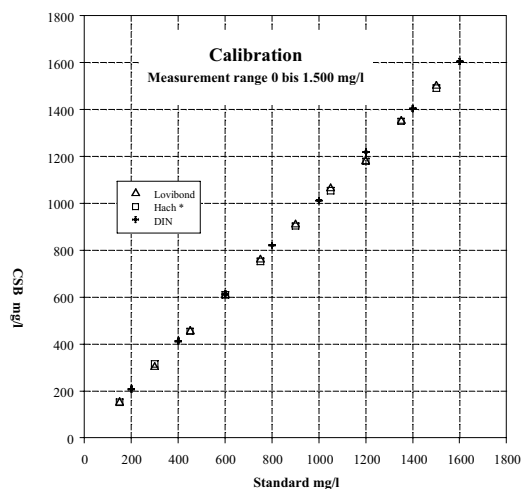
### Graphical representation of the calibration curves for the individual measurement ranges:

Figure 7  
Measurement range 0 - 150 mg/l



COD; Equality of methods 16/01/2003

Figure 8  
Measurement range 0 - 1.500 mg/l

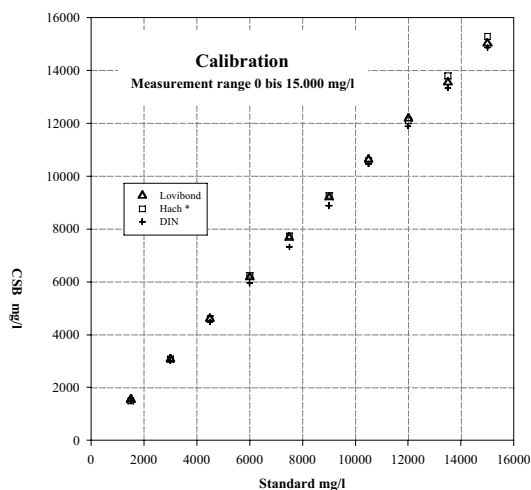


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Figure 9  
Measurement range 0 – 15.000 mg/l



**Literature**

- [1] Furtmann, K., Lokotsch, R. : Praxisbeispiele zur Ermittlung der Gleichwertigkeit von Analysemethoden, GIT Labor-Fachzeitschrift 11/2001
- [2] DIN 32 645; „Nachweis-, Erfassungs- und Bestimmungsgrenze“; Mai 1986
- [3] E DIN 38402-71; „Gleichwertigkeit von zwei Analysenverfahren aufgrund des Vergleiches von Analyseergebnissen und deren statistischer Auswertung; Vorgehensweise für quantitative Merkmale mit kontinuierlichem Wertespektrum (A 71)“; 2001-10

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