SLOVENSKI STANDARD
SIST ISO 1170:1998

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Premog in koks - Preračun analiz na različne osnove

Coal and coke -- Calculation of analyses to different bases

Charbon et coke -- Calculs pour les analyses par rapport à différentes bases

Ta slovenski standard je istoveten z: **ISO 1170:1977**

ICS:

73.040 Premogi Coals

SIST ISO 1170:1998 **en**

INTERNATIONAL STANDARD 1170

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION • МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ • ORGANISATION INTERNATIONALE DE NORMALISATION

Coal and coke — Calculation of analyses to different bases

Charbon et coke — Calculs pour les analyses par rapport à différentes bases

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FOREWORD

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO Member Bodies). The work of developing International Standards is carried out through ISO Technical Committees. Every Member Body interested in a subject for which a Technical Committee has been set up has the right to be represented on that Committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work.

Draft International Standards adopted by the Technical Committees are circulated to the Member Bodies for approval before their acceptance as International Standards by the ISO Council.

Prior to 1972, the results of the work of the technical committees were published as ISO Recommendations; these documents are in the process of being transformed into International Standards. As part of this process, Technical Committee ISO/TC 27, *Solid mineral fuels*, has reviewed ISO Recommendation R 1170-1970 and found it technically suitable for transformation. International Standard ISO 1170 therefore replaces ISO Recommendation R 1170-1970, to which it is technically identical.

ISO Recommendation R 1170 had been approved by the member bodies of the following countries :

Australia	Iran	Spain
Belgium	Israel	Sweden
Canada	Netherlands	Switzerland
Czechoslovakia	New Zealand	Turkey
Denmark	Peru	United Kingdom
Egypt, Arab Rep. of	Poland	U.S.A.
France	Portugal	Yugoslavia
Germany	Romania	
India	South Africa, Rep. of	

No member body had expressed disapproval of the Recommendation.

The member body of the following country disapproved the transformation of the Recommendation into an International Standard :

Czechoslovakia

Printed in Switzerland

INTERNATIONAL STANDARD ISO 1170-1977 (E)/ERRATUM

Published 1977-10-15

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Coal and coke — Calculation of analyses to different bases

ERRATUM

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Symbol F_V should read as follows :

"F_V = volatile matter correction value obtained when using the appropriate national formula"

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Coal and coke – Calculation of analyses to different bases

1 SCOPE AND FIELD OF APPLICATION

This International Standard gives formulae which allow analytical data relating to coal and coke to be expressed on the various different bases in common use. Consideration is given to corrections that may be applied to certain determined values for coal prior to their calculation to other bases.

2 REFERENCES

ISO 157, *Hard coal – Determination of forms of sulphur.*

ISO 334, *Coal and coke – Determination of total sulphur – Eschka method.*

ISO 351, *Coal and coke – Determination of total sulphur – High temperature combustion method.*

ISO 352, *Coal and coke – Determination of chlorine – High temperature combustion method.*

ISO 562, *Hard coal and coke – Determination of the volatile matter.*

ISO 587, *Coal and coke – Determination of chlorine using Eschka mixture.*

ISO 602, *Coal – Determination of mineral matter.*

ISO 609, *Coal and coke – Determination of carbon and hydrogen – High temperature combustion method.*

ISO 625, *Coal and coke – Determination of carbon and hydrogen – Liebig method.*

ISO 925, *Hard coal – Determination of carbon dioxide content – Gravimetric method.*

ISO 1928, *Solid mineral fuels – Determination of gross calorific value by the calorimetric bomb method, and calculation of net calorific value.*

ISO 1994, *Hard coal – Determination of oxygen content.*

3 PRINCIPLE

In order to convert an analytical result expressed on one basis to another basis, it is multiplied by the appropriate formula (see table) after insertion of the requisite numerical values.

4 CALCULATIONS FOR COAL ANALYSES

4.1 Introduction

In International Standards covering the analysis of coal, it is generally specified that the determination shall be carried out on the air-dried analysis sample. However, in making use of these analyses, it is sometimes necessary to express the results on some other basis. The bases in common use are "air-dried", "as received", "dry", "dry, ash free", "dry, mineral matter free".

Any analytical value on a particular basis may be converted to any other basis by multiplying it by the appropriate formula given in the table, after insertion of the numerical values for the symbols. However, in some determinations there is a direct involvement of the mineral matter and, in these cases, it is essential to apply a correction to the air-dried result prior to its calculation to the mineral matter free basis. This correction is dependent on the nature, as well as the quantity, of the mineral matter present and, for any given sample, the formula recommended by the national standards organization of the country of origin of the sample should be used and should be quoted in full, together with the analysis. All the determinations that may be expressed on the dry mineral matter free basis are considered individually below.

It should rarely be necessary to calculate an analytical result expressed on the dry mineral matter free basis back to any other basis but, if the need does arise, then it is essential that any correction deducted during the application of any of the formulae in 4.3 to 4.10 inclusive be *added* back to the dry mineral matter free value before applying the appropriate formula from the table.

4.2 Symbols

The symbols employed in the subsequent clauses are as follows, with the suffixes "ad" (air-dried), "ar" (as received), "d" (dry), "daf" (dry, ash free) or "dmmf" (dry, mineral matter free) where appropriate :

A = ash of the analysis sample (percentage by mass)

C = carbon content of the analysis sample (percentage by mass)

Cl = chlorine content of the analysis sample (percentage by mass)

CO_2 = carbon dioxide content of the analysis sample (percentage by mass)

$Q_{gr,v}$ = gross calorific value at constant volume of the analysis sample

F = oxygen correction value obtained when using the appropriate national formula

F_{Cl} = chlorine correction value obtained when using the appropriate national formula

F_H = hydrogen correction value obtained when using the appropriate national formula

F_V = volatile matter correction value obtained when using the appropriate national formula

H = hydrogen content of the analysis sample (percentage by mass)

M = moisture content of the analysis sample (percentage by mass)

MM = mineral matter content of the analysis sample (percentage by mass) (see annex)

N = nitrogen content of the analysis sample (percentage by mass)

O = oxygen content of the analysis sample (percentage by mass)

S_o = organic sulphur content of the analysis sample (percentage by mass)

S_p = pyritic sulphur content of the analysis sample (percentage by mass)

S_s = sulphate sulphur content of the analysis sample (percentage by mass)

S_T = total sulphur content of the analysis sample (percentage by mass)

V = volatile matter content of the analysis sample (percentage by mass)

4.3 Carbon

In ISO 609 and ISO 625, it is specified that, if the mineral carbonate content is high, the carbon equivalent may be deducted before reporting the carbon on the air-dried basis. Thus :

$$C_{dmmf} = (C_{ad} - 0{,}273\ CO_{2\ ad}) \times \frac{100}{100 - (M_{ad} + MM_{ad})}$$

where the carbon dioxide has been determined on the air-dried analysis sample as given in ISO 925.

4.4 Hydrogen

The hydrogen content reported on the air-dried basis includes the hydrogen of the coal substance and the hydrogen present (as water) in the mineral matter (see ISO 609 and ISO 625). The hydrogen present as moisture in the air-dried sample shall be deducted before reporting H_{ad}. Before calculating the hydrogen of the coal substance to the dry mineral matter free basis, it is also necessary to deduct the hydrogen of the mineral matter. Since the hydrogen in the mineral matter cannot readily be determined, it is generally estimated from a knowledge of the minerals likely to be present and the total mineral matter content. Thus :

$$H_{dmmf} = (H_{ad} - F_H) \times \frac{100}{100 - (M_{ad} + MM_{ad})}$$

4.5 Nitrogen

There is no nitrogen in the mineral state normally associated with coal, and the calculation to the dry mineral matter free basis is

$$N_{dmmf} = N_{ad} \times \frac{100}{100 - (M_{ad} + MM_{ad})}$$

4.6 Sulphur

The total sulphur content, S_T, as reported on the air-dried basis (see ISO 334 and ISO 351), includes organic sulphur, S_o, pyritic sulphur, S_p, and sulphate sulphur, S_s. The pyritic sulphur and the sulphate sulphur can be determined and the organic sulphur obtained by difference (see ISO 157). Thus the organic sulphur is calculated to the dry mineral matter free basis as follows :

$$S_{o,dmmf} = (S_{T,ad} - S_{p,ad} - S_{s,ad}) \times \frac{100}{100 - (M_{ad} - MM_{ad})}$$

4.7 Oxygen

The determined oxygen content (see ISO 1994) includes the oxygen in the coal substance, in the carbonate minerals (as carbon dioxide) and in the silicate minerals (as water). Before calculating the oxygen of the coal substance to the dry mineral matter free basis, it is necessary to deduct the oxygen of the mineral matter. Thus :

$$O_{dmmf} = (O_{ad} - F) \times \frac{100}{100 - (M_{ad} + MM_{ad})}$$

"Oxygen by difference" may be calculated as part of an ultimate analysis on the dry mineral matter free basis and is obtained by subtracting $(C + H + N + S_o + Cl)_{dmmf}$ from 100.

4.8 Chlorine

The chlorine content determined on the analysis sample (see ISO 352 and ISO 587) includes chlorine from the mineral matter and chlorine combined with the coal substance. It is therefore necessary to deduct the inorganic chlorine before calculating to the dry mineral matter free basis :

$$Cl_{dmmf} = (Cl_{ad} - F_{Cl}) \times \frac{100}{100 - (M_{ad} + MM_{ad})}$$

4.9 Volatile matter

The mineral matter associated with a sample also loses mass under the conditions of the volatile matter determination (see ISO 562), the magnitude of the loss being dependent on both the nature and the quantity of the minerals present.

Correction is therefore necessary prior to the calculation of the volatile matter to the dry mineral matter free basis to take account of losses of sulphur, water of hydration, carbon dioxide and chlorine :

$$V_{dmmf} = (V_{ad} - F_V) \times \frac{100}{100 - (M_{ad} + MM_{ad})}$$

4.10 Gross calorific value at constant volume

The gross calorific value at constant volume as reported on the air-dried analysis sample includes the heat liberated by the combustion of pyrites to iron(III) oxide and sulphur dioxide as well as that from the combustion of the coal substance. It is therefore necessary to subtract the heat of combustion of the pyrites to iron(III) oxide (12,690 kJ/mol) prior to the calculation of the calorific value to the mineral matter free basis. Thus :

$$Q_{gr,v,dmmf} = (Q_{gr,v,ad} - 70\,S_{p,ad}) \times \frac{100}{100 - (M_{ad} - MM_{ad})}$$

The calculation of net calorific value is dealt with in detail in ISO 1928.

5 CALCULATIONS FOR COKE ANALYSES

Coke analyses may be expressed on the "air-dried", "as received", "dry" and "dry, ash free" bases, and these values are calculated by the use of the appropriate formulae given in the table, after insertion of numerical values for the symbols.

It is not proposed at present to recommend the calculation of analytical results on coke to the dry mineral matter free basis.

TABLE – **Formulae for calculation of results to different bases**

Given \ Wanted	As analysed (air dried) (ad)	As received[1] (ar)	Dry (d)	Dry, ash free (daf)	Dry, mineral matter free (dmmf)
As analysed (air dried) (ad)		$\frac{100}{100 - M_{ad}}$	$\frac{100}{100 - M_{ad}}$	$\frac{100}{100 - (M_{ad} + A_{ad})}$	$\frac{100}{100 - (M_{ad} + MM_{ad})}$
As received (ar)	$\frac{100 - M_{ad}}{100 - M_{ar}}$		$\frac{100}{100 - M_{ar}}$	$\frac{100}{100 - (M_{ar} + A_{ar})}$	$\frac{100}{100 - (M_{ar} + MM_{ar})}$
Dry (d)	$\frac{100 - M_{ad}}{100}$	$\frac{100 - M_{ar}}{100}$		$\frac{100}{100 - A_d}$	$\frac{100}{100 - MM_d}$
Dry, ash free (daf)	$\frac{100 - (M_{ad} + A_{ad})}{100}$	$\frac{100 - (M_{ar} + A_{ar})}{100}$	$\frac{100 - A_d}{100}$		$\frac{100 - A_d}{100 - MM_d}$
Dry, mineral matter free (dmmf)	$\frac{100 - (M_{ad} + MM_{ad})}{100}$	$\frac{100 - (M_{ar} + MM_{ar})}{100}$	$\frac{100 - MM_d}{100}$	$\frac{100 - MM_d}{100 - A_d}$	

1) Note that the formulae given for calculating results to the "as received" basis may be used to calculate them to any other moisture basis, for example capacity moisture or bed moisture.