भारतीय मानक

Indian Standard

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औद्योगिक अपशिष्ट जल वर्गीकरण

Industrial Wastewater Classification

ICS 13.030.20

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NATIONAL FOREWORD

This Indian Standard which is identical to ISO 22447 ‘Industrial wastewater classification’ issued by the International Organization for Standardization (ISO) was adopted by the Bureau of Indian Standards on the recommendation of the Environment Protection Sectional Committee and approval of the Chemical Division Council.

This document specifies the principles, categories, and codes for the classification of industrial wastewater and is applicable to all types and sources of industrial wastewater. It provides a broad framework classifying industrial wastewater into different categories based on industry type and the associated water quality constituents, namely physical, chemical and biological characteristics with a specific code assigned based on both industry type and waste-stream classification.

The text of ISO standard has been approved as suitable for publication as an Indian Standard without deviations. Certain conventions and terminologies are, however, not identical to those used in Indian Standards. Attention is particularly drawn to the following:

a) Wherever the words ‘International Standard’ appear referring to this standard, they should be read as ‘Indian Standard’; and

b) Comma (,) has been used as a decimal marker in the International Standard, while in Indian Standards, the current practice is to use a point (.) as the decimal marker.

Textual Error — When adopting the text of the International Standard, the textual error given below was discovered. It has been marked in the text:

Error	*Correction*
An exception is when m = 9, the number may be rounded as 10 × 10n, in this case, instead of writing it as 10n, it should be written as 1(n + 1), for example, 9,875 should be written as 11.	An exception is when m = 9, the number may be rounded as 10 × 10n, in this case, instead of writing it as 10n, it should be written as 1(n + 1), for example, 9,875 should be written as 14.

In this adopted standard, reference appears to certain International Standards where the standard atmospheric conditions to be observed are stipulated which are not applicable to tropical/subtropical countries. The applicable standard atmospheric conditions for Indian conditions are (27 ± 2) °C and (65 ± 5) percent, relative humidity and shall be observed while using this standard.

In reporting the result of a test or analysis made in accordance with this standard if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS 2 : 2022 ‘Rules for rounding off numerical values (*second revision*)’.

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Introduction

Industrial wastewater is produced by many kinds of industries. In some parts of the world, climate change is putting water resources under stress. Treatment of industrial wastewater provides an opportunity for resource recovery, which can help to drought-proof ongoing operations. Reclaiming and reusing industrial wastewater reduces demands on limited freshwater resources, as well as the amount of wastewater and the associated contaminants that are released to the environment. How to process and reuse industrial wastewater efficiently is a great challenge as wastewater characteristics are as complex and varied as the industries that produce these waste-streams. Industrial wastewater contains a wide range of inorganic and complex organic contaminants, with various concentrations and almost as wide a range of potential physical, chemical and biological treatment processes and has specific treated water quality required for reuse. A clear ISO industrial wastewater classification and coding system is needed to assist both industry and government to record the information of wastewater (including industrial type and water quality parameter) and provide some information on identifying best available control technologies and treatment performance capabilities in order to establish reasonable expectations and facilitate the development of universal wastewater treatment technologies in industrial reuse, and promote the information communication during commercial trade, for example, bidding, consultation, and so on.

The industrial wastewater classification system described in this document covers the basic and most important information required to properly characterize industrial process waste-streams to quickly determine the requirement of the appropriate treatment or reuse technology options for specific industries, reduce operating costs for enterprises, and ultimately promote the systematic development of process water treatment and reuse technologies for industrial application. For the government and large corporations, a more important usage of the classification and coding system is to help them with establishment and improvement of standards concerning discharge and reuse of industrial wastewater.

This document provides a wastewater classification framework and coding system, along with a water quality parameter list. The usages of the classification and coding system facing different users, namely the entrepreneur or the government, are provided in Annex A. It is intended that this classification system will help to promote understanding between different business parties, governments, to collaboratively develop wastewater treatment and reuse technologies among different countries, improve the efficiency of industrial wastewater reuse, and save and protect environment. Due to the similar nature, it may also apply for the wastewater treatment concerning discharge.

Indian Standard

INDUSTRIAL WASTEWATER CLASSIFICATION

1 Scope

This document specifies the principles, categories, and codes for the classification of industrial wastewater and is applicable to all types and sources of industrial wastewater. It provides a broad framework classifying industrial wastewater into different categories based on industry type and the associated water quality constituents, namely physical, chemical and biological characteristics with a specific code assigned based on both industry type and waste-stream classification.

2 Normative references

There are no normative references in this document.

3 Terms, definitions and abbreviated terms

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at http:// www.iso.org/obp

— IEC Electropedia: available at http:// www.electropedia.org/

3.1 Terms and definitions

3.1.1
biochemical oxygen demand
BOD
mass concentration of dissolved oxygen consumed under specified conditions by the aerobic biological oxidation of a chemical compound or organic matter in water

Note 1 to entry: BOD_5: Degradation time = 5 days; Temperature = 20 °C.

[SOURCE: ISO 9408:1999]

3.1.2
chemical oxygen demand
COD
mass concentration of oxygen equivalent to the amount of dichromate consumed by dissolved and suspended matter when a water sample is treated with that oxidant under defined conditions

[SOURCE: ISO 6107-2:2006]

3.1.3
EC_{50}
concentration estimated to cause an effect on a test end-point in 50 % of an exposed population over a defined exposed period

[SOURCE: ISO 16387:2014]

3.1.4
free chlorine
chlorine present in the form of hypochlorous acid, hypochlorite ions or dissolved elemental chlorine

[SOURCE: ISO 7027:1999]

3.1.5
total coliforms
group of aerobic and facultatively anaerobic Gram-negative, non-spore-forming, lactose-fermenting bacteria which typically inhabit the large intestine of man and animals

[SOURCE: ISO 6107-7:2006]

3.1.6
total dissolved solids (TDS)
weight of inorganic and organic matter in true solution per unit volume of water

[SOURCE: ISO 16345:2014]

3.1.7
total hardness
total concentration of calcium and magnesium

[SOURCE: ISO 6059:1984]

3.1.8
total kjeldahl nitrogen
TKN
concentration of organic nitrogen and ammoniacal nitrogen in a sample, determined under specified conditions based on digestion with sulfuric acid

[SOURCE: ISO 6107-8:1993]

3.1.9
total nitrogen
sum of *total kjeldahl nitrogen* (3.1.8) (ammonia, organic and reduced nitrogen) and nitrate-nitrite

3.1.10
total organic carbon
TOC
all the carbon present in organic matter which is dissolved and suspended in the water

[SOURCE: ISO 11733:2004]

3.1.11
total phosphorus
sum of all phosphorus compounds that occur in various forms

3.1.12
total residual chlorine
chlorine present in the form of *free chlorine* (3.1.4) or combined chlorine, or both

[SOURCE: ISO 7027:1999]

3.1.13
total solids
TS
sum of dissolved and suspended solids

[SOURCE: ISO 6107-2:2006]

3.1.14
total suspended solids
TSS
weight of particulates, both organic and inorganic, suspended, but not dissolved, per unit of water

[SOURCE: ISO 16345:2014]

3.1.15
turbidity
reduction of transparency of a liquid caused by the presence of undissolved matter

[SOURCE: ISO 7027:1999]

3.1.16
96 h LC_{50}
bioassay determining the dilution of an effluent which causes the death of 50 % (one half) of a group of test animals (typically rainbow trout) after exposure for 96 hours

3.2 Abbreviated terms

BOD_5	biochemical oxygen demand after 5 days
COD	chemical oxygen demand
DO	dissolved oxygen
EC	electrical conductivity
FOG	fat, oil and grease
n.e.c.	not elsewhere classified
SDI	silting density index
TDS	total dissolved solids
TKN	total Kjeldahl nitrogen
TN	total nitrogen
TOC	total organic carbon
TOD	total oxygen demand
TP	total phosphorus
TS	total solids
TSS	total suspended solids

4 Classification of industrial wastewater

4.1 Classification principle and code structure for industrial wastewater classification

4.1.1 Classification principle

Industrial processes, even in the same industry (e.g. pulp and paper), characteristically generate different distinctive waste-streams as a result of differences between production processes.

Consequently, the effectiveness of a particular technology or a group of technologies can be expected to be varied, and require different wastewater treatment processes and reuse technologies.

In this document, hierarchical classification is used to classify different levels of industrial wastewater based on: type of the industry (Level 1) and water quality parameters (e.g. pH, TSS, TDS, COD, TN and TP) (Level 2). The relationship between different levels is shown in Figure 1. Level 1 and Level 2 have a progressive relationship.

This classification system defines the basic and most important characteristics of industrial wastewater from different dimensions. It is intended to guide technology selection and design for industrial wastewater treatment and reuse. Although some reference codes are provided in this document, the relevant and suitable parameters can be selected according to local industrial wastewater quality and technological conditions in different countries or regions.

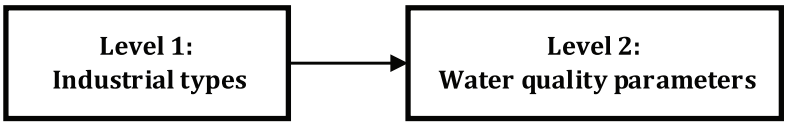

Figure 1 — Relationship between different levels of industrial wastewater classification

4.1.2 Code structure

The code of industrial wastewater classification adopts hierarchical code. The hierarchy corresponding to the classification of industrial wastewater is divided into two levels. The hierarchical code of each level is in an ascending order.

The hierarchy code structure of industrial wastewater classification contains two levels (Figure 2). Level 1 (the first two digits) indicates the classification according to industry types, which uses two letters following the alphabetic order for each letter (from A to Z, then from a to z, which is 52 codes for each digit). Level 2 (the number of digits is determined by the number of water quality parameters included; each parameter has a four-digit-code) indicates the classification according to the water quality of the industrial wastewater. A hyphen is used for distinguishing between each water quality parameter.

For Level 2, if some water quality indexes are irrelevant to the certain industrial type, the corresponding codes should not be included. However, if it is still necessary for considering the requirements or the effects of those water quality indexes with no available value, the value of the parameter should be set as 0a as a default value.

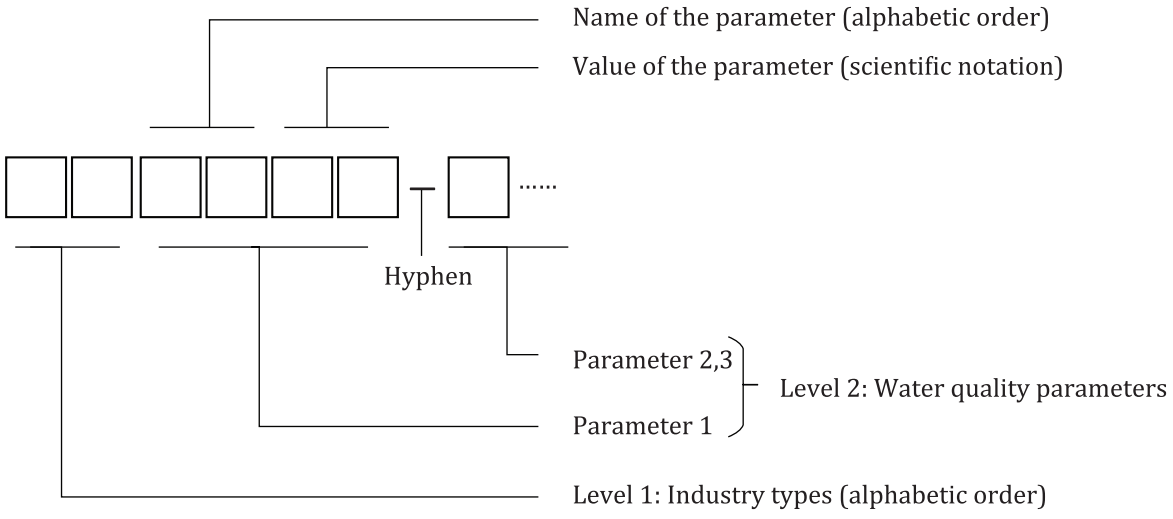

Figure 2 — Code structure of industrial wastewater classification

4.2 Classification of industrial wastewater based on industrial types (Level 1)

Wastewater generated from different industries may have distinct water qualities. On this level, wastewater is classified according to industrial types in the areas of mining and quarrying, manufacturing, electricity, gas, steam and air conditioning supply, water supply, construction and the like. A recommended list of code vs. category of industrial wastewater according to industrial types is shown in Table 1, which mainly follows the International Standard Industrial Classification of All Economic Activities[10], added up with special wastewater including laboratory wastewater, nuclear and radioactivity wastewater, and mixed wastewater that come from more than one industry category included in this level[11][12]. Each type of industrial wastewater is given a two-letter code following alphabetic order (for each letter, from A to Z, then a to z if necessary). A total of 207 types of industrial wastewater were included, among which 34 big categories are coded as "*A" (* means a character), and shown as bold font in the table.

For the plants manufacturing products which belong to different industrial types, or in other situations that the wastewaters are mixed before reuse or discharge, if two types belong to the same big category, e.g. a mine produces both iron ore and rare earth, the mixed wastewater should be classified following the big category name, so does the code; if two types belong to different big categories, several possible mixed sub-categories are listed under the category of "mixed wastewater" (g*).

Governments, regional administrations, industrial sectors, and other users can edit and modify the information according to the specific situations. For the types of industry that are not included or newly appeared, the table can also be extended accordingly, or the wastewater can be classified as "other industrial wastewater" (hA). If there are modifications of the corresponding list, an illustration of the coding system should be provided in the document when applying.

Table 1 — Category and code for industrial wastewater based on industrial types

Code	Category name
AA	**coal and lignite mining wastewater**
AB	hard coal mining wastewater
AC	lignite mining wastewater
BA	**crude petroleum and natural gas extraction wastewater**
BB	crude petroleum extraction wastewater
BC	natural gas extraction wastewater
CA	**metal ores mining wastewater**
CB	iron ores mining wastewater
CC	non-ferrous metal ores mining wastewater
DA	**other mining and quarrying wastewater**
DB	stone, sand and clay quarrying wastewater
DC	chemical and fertilizer minerals mining wastewater
DD	peat extraction wastewater
DE	salt extraction wastewater
DF	other mining and quarrying wastewater n.e.c.
EA	**food products manufacturing wastewater**
EB	meat processing and preserving wastewater
EC	fish, crustaceans and molluscs processing and preserving wastewater
ED	fruit and vegetables processing and preserving wastewater
EE	vegetable and animal oils and fats manufacturing wastewater
EF	dairy products manufacturing wastewater
EG	grain mill products, starches and starch products manufacturing wastewater
EH	grain mill products manufacturing wastewater

Table 1 *(continued)*

Code	Category name
EI	starches and starch products manufacturing wastewater
EJ	bakery products manufacturing wastewater
EK	sugar manufacturing wastewater
EL	cocoa, chocolate and sugar confectionery manufacturing wastewater
EM	macaroni, noodles, couscous and similar farinaceous products manufacturing wastewater
EN	prepared meals and dishes manufacturing wastewater
EO	other food products manufacturing wastewater
EP	prepared animal feeds manufacturing wastewater
FA	**beverages manufacturing wastewater**
FB	spirits distilling, rectifying and blending wastewater
FC	wines manufacturing wastewater
FD	malt liquors and malt manufacturing wastewater
FE	soft drinks, mineral waters and other bottled waters manufacturing wastewater
GA	**tobacco products manufacturing wastewater**
HA	**textiles manufacturing wastewater**
HB	textiles spinning, weaving and finishing wastewater
HC	textiles fibre preparation and spinning wastewater
HD	textiles weaving wastewater
HE	textiles finishing wastewater
HF	knitted and crocheted fabrics manufacturing wastewater
HG	made-up textile articles (except apparel) manufacturing wastewater
HH	carpets and rugs manufacturing wastewater
HI	cordage, rope, twine and netting manufacturing wastewater
HJ	other textiles manufacturing wastewater
IA	**wearing apparel manufacturing wastewater**
IB	wearing apparel (except fur apparel) manufacturing wastewater
IC	articles of fur manufacturing wastewater
ID	knitted and crocheted apparel manufacturing wastewater
IE	other wearing apparel manufacturing wastewater
JA	**leather and related products manufacturing wastewater**
JB	leather tanning and dressing wastewater
JC	fur dressing and dyeing wastewater
JD	luggage, handbags and the like, saddlery and harness manufacturing wastewater
JE	footwear manufacturing wastewater
JF	other leather and related products manufacturing wastewater
KA	**wood, wood products and cork (except furniture) manufacturing wastewater; articles of straw and plaiting materials manufacturing wastewater**
KB	wood sawmilling and planning wastewater
KC	products of wood, cork, straw and plaiting materials manufacturing wastewater
KD	veneer sheets and wood-based panels manufacturing wastewater
KE	builders' carpentry and joinery manufacturing wastewater
KF	wooden containers manufacturing wastewater
KG	other products of wood; manufacture of articles of cork, straw and plaiting materials manufacturing wastewater

Table 1 *(continued)*

Code	Category name
LA	**paper and paper products manufacturing wastewater**
LB	pulp, paper and paperboard manufacturing wastewater
LC	corrugated paper and paperboard and containers of paper and paperboard manufacturing wastewater
LD	other articles of paper and paperboard manufacturing wastewater
MA	**coke and refined petroleum products manufacturing wastewater**
MB	coke oven products manufacturing wastewater
MC	refined petroleum products manufacturing wastewater
NA	**chemicals and chemical products manufacturing wastewater**
NB	basic chemicals manufacturing wastewater
NC	fertilizers and nitrogen compounds manufacturing wastewater
ND	plastics and synthetic rubber in primary forms manufacturing wastewater
NE	pesticides and other agrochemical products manufacturing wastewater
NF	paints, varnishes and similar coatings, printing ink and mastics manufacturing wastewater
NG	soap and detergents, cleaning and polishing preparations, perfumes and toilet preparations manufacturing wastewater
NH	man-made fibres manufacturing wastewater
NI	other chemicals and chemical products manufacturing wastewater
OA	**pharmaceuticals, medicinal chemical and botanical products manufacturing wastewater**
PA	**rubber and plastics products manufacturing wastewater**
PB	rubber tyres and tubes, retreading and rebuilding of rubber tyres manufacturing wastewater
PC	other rubber products manufacturing wastewater
PD	plastics products manufacturing wastewater
QA	**non-metallic mineral products manufacturing wastewater**
QB	glass and glass products manufacturing wastewater
QC	refractory products manufacturing wastewater
QD	clay building materials manufacturing wastewater
QE	other porcelain and ceramic products manufacturing wastewater
QF	cement, lime and plaster manufacturing wastewater
QG	articles of concrete, cement and plaster manufacturing wastewater
QH	Cutting, shaping and finishing of stone wastewater
QI	other non-metallic mineral products manufacturing wastewater
RA	**basic metals manufacturing wastewater**
RB	basic iron and steel manufacturing wastewater
RC	basic precious and other non-ferrous metals manufacturing wastewater
RD	iron and steel casting wastewater
RE	non-ferrous metals casting wastewater
SA	**fabricated metal products (except machinery and equipment) manufacturing wastewater**
SB	structural metal products, tanks, reservoirs and steam generators manufacturing wastewater
SC	structural metal products manufacturing wastewater
SD	tanks, reservoirs and containers of metal manufacturing wastewater
SE	steam generators (except central heating hot water boilers) manufacturing wastewater
SF	weapons and ammunition manufacturing wastewater
SG	metal forging, pressing, stamping and roll-forming wastewater; powder metallurgy wastewater

Table 1 *(continued)*

Code	Category name
SH	metal treatment and coating wastewater; machining wastewater
SI	cutlery, hand tools and general hardware manufacturing wastewater
SJ	other fabricated metal products manufacturing wastewater
TA	**computer, electronic and optical products manufacturing wastewater**
TB	electronic components and boards manufacturing wastewater
TC	computers and peripheral equipment manufacturing wastewater
TD	communication equipment manufacturing wastewater
TE	consumer electronics manufacturing wastewater
TF	measuring, testing, navigating and control equipment, watches and clocks manufacturing wastewater
TG	measuring, testing, navigating and control equipment manufacturing wastewater
TH	watches and clocks manufacturing wastewater
TI	irradiation, electromedical and electrotherapeutic equipment manufacturing wastewater
TJ	optical instruments and photographic equipment manufacturing wastewater
TK	magnetic and optical media manufacturing wastewater
UA	**electrical equipment manufacturing wastewater**
UB	electric motors, generators, transformers and electricity distribution and control apparatus manufacturing wastewater
UC	batteries and accumulators manufacturing wastewater
UD	wiring and wiring devices manufacturing wastewater
UE	fibre optic cables manufacturing wastewater
UF	other electronic and electric wires and cables manufacturing wastewater
UG	wiring devices manufacturing wastewater
UH	electric lighting equipment manufacturing wastewater
UI	domestic appliances manufacturing wastewater
UJ	other electrical equipment manufacturing wastewater
VA	**machinery and equipment n.e.c. manufacturing wastewater**
VB	general-purpose machinery manufacturing wastewater
VC	engines and turbines manufacturing wastewater
VD	fluid power equipment manufacturing wastewater
VE	other pumps, compressors, taps and valves manufacturing wastewater
VF	bearings, gears, gearing and driving elements manufacturing wastewater
VG	ovens, furnaces and furnace burners manufacturing wastewater
VH	lifting and handling equipment manufacturing wastewater
VI	office machinery and equipment (except computers and peripheral equipment) manufacturing wastewater
VJ	power-driven hand tools manufacturing wastewater
VK	other general-purpose machinery manufacturing wastewater
VL	special-purpose machinery manufacturing wastewater
VM	agricultural and forestry machinery manufacturing wastewater
VN	metal-forming machinery and machine tools manufacturing wastewater
VO	machinery for metallurgy manufacturing wastewater
VP	machinery for mining, quarrying and construction manufacturing wastewater
VQ	machinery for food, beverage and tobacco processing manufacturing wastewater
VR	machinery for textile, apparel and leather production manufacturing wastewater

Table 1 *(continued)*

Code	Category name
VS	other special-purpose machinery manufacturing wastewater
WA	**motor vehicles, trailers and semi-trailers manufacturing wastewater**
WB	motor vehicles manufacturing wastewater
WC	bodies (coachwork) for motor vehicles manufacturing wastewater
WD	trailers and semi-trailers manufacturing wastewater
WE	parts and accessories for motor vehicles manufacturing wastewater
XA	**other transport equipment manufacturing wastewater**
XB	ships and boats building wastewater
XC	ships and floating structures building wastewater
XD	pleasure and sporting boats building wastewater
XE	railway locomotives and rolling stock manufacturing wastewater
XF	air and spacecraft and related machinery manufacturing wastewater
XG	military fighting vehicles manufacturing wastewater
XH	transport equipment manufacturing wastewater
XI	motorcycles manufacturing wastewater
XJ	bicycles and invalid carriages manufacturing wastewater
XK	other transport equipment manufacturing wastewater
YA	**furniture manufacturing wastewater**
ZA	**other manufacturing wastewater**
ZB	jewellery, bijouterie and related articles manufacturing wastewater
ZC	jewellery and related articles manufacturing wastewater
ZD	imitation jewellery and related articles manufacturing wastewater
ZE	musical instruments manufacturing wastewater
ZF	sports goods manufacturing wastewater
ZG	games and toys manufacturing wastewater
ZH	medical and dental instruments and supplies manufacturing wastewater
ZI	other manufacturing wastewater
aA	**discarded resource and waste material recovery and processing wastewater**
aB	metal scrap and dross processing wastewater
aC	non-metal scrap and dross processing wastewater
aD	other discarded resource and waste material recovery and processing wastewater
bA	**wastewater related to electricity, gas, steam and air conditioning supply**
cA	**wastewater related to water production and supply**
cB	wastewater related to tap water production and supply
cC	other wastewater generated by water treatment, use and distribution
dA	**construction wastewater**
eA	**nuclear and radioactivity wastewater**
eB	radioactive metal mining and dressing wastewater
eC	nuclear fuel and raw material processing wastewater
eD	nuclear radiation processing wastewater
eE	radioactive chemical product manufacturing wastewater
eF	nuclear power plant wastewater
eG	other nuclear and radioactivity wastewater
fA	**laboratory wastewater**

Table 1 *(continued)*

Code	Category name
fB	engineering and technical laboratory wastewater
fC	agricultural laboratory wastewater
fD	medical laboratory wastewater
fE	other laboratory wastewater
gA	**mixed wastewater**
gB	mixed wastewater from mining of metal ores and other mining and quarrying
gC	mixed wastewater from food products manufacturing and beverages manufacturing
gD	mixed wastewater from textiles manufacturing and wearing apparel manufacturing
gE	mixed wastewater from wood and wood products manufacturing and furniture manufacturing
gF	mixed wastewater from chemicals and chemical products manufacturing and rubber and plastics products manufacturing
gG	mixed wastewater from basic metals manufacturing and fabricated metal products manufacturing
gH	mixed wastewater from computer, electronic and optical products manufacturing and electrical equipment manufacturing
gI	mixed wastewater from motor vehicles, trailers and semi-trailers manufacturing and other transport equipment manufacturing
hA	**other industrial wastewater**
...	

4.3 Classification of industrial wastewater based on water quality parameters (Level 2)

An open coding system is provided on this level to guide different governments, regional administrations and industrial sectors to choose relevant water quality parameters (e.g. pH, TSS, TDS, COD, TN and TP). For each parameter, a four-digit-code is provided, the first two digits indicate the parameter's name, and the last two indicate the measured value of the parameter.

For the parameter name, two digits following the alphabetical order (from A to Z) are recommended. The codes of 92 water quality parameters that belong to 7 types are listed in Table 2. For the water quality parameters that are not included or newly appeared, the table can also be extended accordingly, or it can be classified as "other parameters" (HA). A detailed usage guideline of the list is given in Annex A. Users can edit, modify, or extend the information according to their own situations, if so, an illustration of the coding system should be provided in the document when applying.

Level 2 is recommended to use two digits' scientific notation, which expresses a number as a form of $mn = m \times 10^n$ ($m \neq 0$, $1 \leq |n| < 10$, n is an integer) is most frequently used in this list, to represent the measured value of water quality parameters.

If $n \geq 0$,

1. the value can be directly written as $m \times 10^n$, e.g. 8 000 written as 83; 6 written as 60;
2. if the value is written as *m.lop...* $\times 10^n$, the number will be *(m + 1)n or mn* by using international Rounding Rules, for example, 7 165 written as 73;
3. an exception is when $m = 9$, the number may be rounded as 10×10^n, in this case, instead of writing it as *10n*, it should be written as *1(n + 1)*, for example, 9,875 should be written as 11.

If $n < 0$, the "–1 to –9" should be presented as alphabetical order "a to *i*", i.e., –1 written as a, –2 as b...–9 as *i*. Other rules are the same as $n \geq 0$. For example, 0,008 3 written as 8c; 0,000 553 96 written as 6d; 0,097 written as 1a.

If some water quality indexes are irrelevant to the certain industrial type, the corresponding codes should not be included. However, if it's still necessary for considering the requirements or the effects of

several water quality indexes with no available value, the value of the parameter should be set as 0a as a default value.

Since the units of different water quality values were mostly mg/l, the value of $|n|$ is unlikely to be larger than 9.

A hyphen is used for distinguishing between each water quality parameter.

Table 2 — Codes vs. parameter names of water quality of industrial wastewater

Code	Water quality parameter name	Units	Value
A	**Physical parameters**		
AA	Temperature	°C	00-99
AB	Colour	colour unit	$m \times 10^n$
AC	Turbidity	NTU	$m \times 10^n$
AD	Electrical Conductivity (EC)	µS/cm	$m \times 10^n$
AE	Odor	odor unit	$m \times 10^n$
AF	Radioactive	Bq/l	$m \times 10^n$
B	**Basic chemical parameters**		
BA	pH		00-14
BB	Dissolved Oxygen (DO)	mg/l	$m \times 10^n$
BC	Total Organic Carbon (TOC)	mg/l	$m \times 10^n$
BD	Total Dissolved Solids (TDS)	mg/l	$m \times 10^n$
BE	Total Suspended Solids (TSS)	mg/l	$m \times 10^n$
BF	Total Hardness	mg/l (as $CaCO_3$)	$m \times 10^n$
BG	Biological Oxygen Demand (BOD)	mg/l	$m \times 10^n$
BH	5 Days 20°C BOD (BOD_5)	mg/l	$m \times 10^n$
BI	Chemical Oxygen Demand (COD)	mg/l	$m \times 10^n$
BJ	Silting Density Index (SDI)		00-99
BK	M-Alkalinity	mg/l (as $CaCO_3$) or mmol/l	$m \times 10^n$
BL	P-Alkalinity	mg/l (as $CaCO_3$) or mmol/l	$m \times 10^n$
C	**Organic matters**		
CA	Fat, Oil and Grease (FOG)	mg/l	$m \times 10^n$
CB	Formaldehyde	mg/l	$m \times 10^n$
CC	Phenols	mg/l	$m \times 10^n$
CD	Pesticide	mg/l	$m \times 10^n$
CE	Detergents	mg/l	$m \times 10^n$
CF	Polychlorinated Biphenyls	mg/l	$m \times 10^n$
CG	Carbon Tetrachloride	mg/l	$m \times 10^n$
CH	Hexachlorobenzene	mg/l	$m \times 10^n$
CI	DTT	mg/l	$m \times 10^n$
CJ	Endrin	mg/l	$m \times 10^n$
CK	Dieldrin	mg/l	$m \times 10^n$
CL	Aldrin	mg/l	$m \times 10^n$
CM	Isodrin	mg/l	$m \times 10^n$
CN	Perchloroethylene	mg/l	$m \times 10^n$
CO	Hexachlorobutadiene	mg/l	$m \times 10^n$
CP	Chloroform	mg/l	$m \times 10^n$

NOTE The parameters of wastewater are quoted from existed standards, see References [13] to [20].

Table 2 *(continued)*

Code	Water quality parameter name	Units	Value
CQ	1,2 Dichloro Ethylene	mg/l	$m \times 10^n$
CR	Trichloroethylene	mg/l	$m \times 10^n$
CS	Trichlorobenzene	mg/l	$m \times 10^n$
CT	Benzene	mg/l	$m \times 10^n$
CU	Methylbenzene	mg/l	$m \times 10^n$
CV	Ethylbenzene	mg/l	$m \times 10^n$
CW	Chlorobenzene	mg/l	$m \times 10^n$
CX	Trichloromethane	mg/l	$m \times 10^n$
CY	Tetrachloroethylene	mg/l	$m \times 10^n$
CZ	Propylene	mg/l	$m \times 10^n$
Ca	n-Hexane extraction	mg/l	$m \times 10^n$
Cb	Volatile Organic Carbon	mg/l	$m \times 10^n$
Cc	Total Petroleum Hydrocarbon	mg/l	$m \times 10^n$
D	**Inorganic matters**		
DA	Sulphide (S)	mg/l	$m \times 10^n$
DB	Sulfate	mg/l	$m \times 10^n$
DC	Free Chlorine	mg/l	$m \times 10^n$
DD	Chloridion	mg/l	$m \times 10^n$
DE	Total Residual Chlorine	mg/l	$m \times 10^n$
DF	Fluorides (F)	mg/l	$m \times 10^n$
DG	Cyanide (as HCN)	mg/l	$m \times 10^n$
DH	Silicium (SiO_2)	mg/l	$m \times 10^n$
E	**Nutrient elements**		
EA	Total Kjeldahl Nitrogen (TKN)	mg/l	$m \times 10^n$
EB	Free Ammonia (NH_3)	mg/l	$m \times 10^n$
EC	Ammonia as N	mg/l	$m \times 10^n$
ED	Nitrate+ Nitrite as N	mg/l	$m \times 10^n$
EE	Nitrate as N	mg/l	$m \times 10^n$
EF	Nitrite as N	mg/l	$m \times 10^n$
EG	Total Nitrogen	mg/l	$m \times 10^n$
EH	Phosphate (PO_4)	mg/l	$m \times 10^n$
EI	Ortho Phosphorous, Dissolved as P	mg/l	$m \times 10^n$
EJ	Phosphorous	mg/l	$m \times 10^n$
EK	Total Phosphorus	mg/l	$m \times 10^n$
EL	Potassium (K)	mg/l	$m \times 10^n$
EM	Sodium (Na)	mg/l	$m \times 10^n$
F	**Metals**		
FA	Aluminium (Al)	mg/l	$m \times 10^n$
FB	Arsenic (As)	mg/l	$m \times 10^n$
FC	Boron (B)	mg/l	$m \times 10^n$
FD	Barium (Ba)	mg/l	$m \times 10^n$
FE	Cobalt (Be)	mg/l	$m \times 10^n$
FF	Calcium (Ca)	mg/l	$m \times 10^n$

NOTE The parameters of wastewater are quoted from existed standards, see References [13] to [20].

Table 2 *(continued)*

Code	Water quality parameter name	Units	Value
FG	Copper (Cu)	mg/l	$m \times 10^n$
FH	Cadmium (Cd)	mg/l	$m \times 10^n$
FI	Chromium (Hexavalent)	mg/l	$m \times 10^n$
FJ	Chromium (Trivalent)	mg/l	$m \times 10^n$
FK	Total Chromium	mg/l	$m \times 10^n$
FL	Cobalt (Co)	mg/l	$m \times 10^n$
FM	Iron (Fe)	mg/l	$m \times 10^n$
FN	Lead (Pb)	mg/l	$m \times 10^n$
FO	Magnesium (Mg)	mg/l	$m \times 10^n$
FP	Manganese (Mn)	mg/l	$m \times 10^n$
FQ	Mercury (Hg)	mg/l	$m \times 10^n$
FR	Molybdenum (Mo)	mg/l	$m \times 10^n$
FS	Nickel (Ni)	mg/l	$m \times 10^n$
FT	Selenium (Se)	mg/l	$m \times 10^n$
FU	Tin (Sn)	mg/l	$m \times 10^n$
FV	Zinc (Zn)	mg/l	$m \times 10^n$
G	**Biological parameters**		
GA	Total Coliforms	CFU/100l	$m \times 10^n$
GB	Faecal Coliform	CFU/100l	$m \times 10^n$
GC	Virus	PFU/l	$m \times 10^n$
GD	Toxicity (Luminescent bacteria test, EC_{50})	%	00-99
GE	Toxicity (Rainbow trout test, 96 hr LC_{50})	%	00-99
HA	**Other parameters**		
…	……		
NOTE The parameters of wastewater are quoted from existed standards, see References [13] to [20].			

Annex A
(informative)

Classification and reuse by case study

In this document, industrial wastewater classification codes are used to provide basic information about the wastewater characteristics including: type of the industry and water quality parameters. This information is useful to guide the commercial trade between different business parties or with the national and regional governments. The collection of the data can also help to define the application of specific water reuse technologies, establish new standards or rules, and to improve the requirements of treatment performance in a specific industry.

A.1 The usage in commercial trade

The classification of industrial wastewater and its coding system can largely simplify the commercial trade, for example, if an enterprise in steel industry produces wastewater with parameters listed in Table A.1, and is looking for suppliers to provide treatment for discharge or reuse, in the bidding document, the codes of in/effluent can be used for presenting the requirement instead of listing them as a table, such as Table A.1, see Reference [21].

Table A.1 — Code and value of industrial wastewater parameters in an ideal steel plant

Code	**Category name**		
RB	Basic iron and steel manufacturing wastewater		
Code	**Water quality parameter**	**Influent**	**Effluent**
BB	Electrical Conductivity (EC) (μS/cm)	5 300	650
BF	Total Hardness (mg/l as $CaCO_3$)	220	200
DD	Chloridion (mg/l)	320	80
DC	Sulphate (mg/l)	680	180
FJ	Iron (mg/l)	1,0	0,05
FS	Strontium (mg/l)	9,8	3,5
FA	Aluminium (mg/l)	0,6	0,2
BA	pH	8,5	8,0
CA	Fat, Oil and Grease (FOG) (mg/l)	14	ND
BJ	Silting Density Index (SDI)	NA	5,0

In this case, Table A.1 provides values of the top 10 most important wastewater quality parameters for the treatment and reuse system bidding by the steel plant, the code of the influent is

RBBA08-BB53-BF22-BJ0a-CA11-DC72-DD32-FA6a-FJ10-FS11

while the code for the quality of the effluent of treatment system is

RBBA08-BB62-BF22-BJ05-CA0a-DC22-DD81-FA2a-FJ5b-FS40

Please note that, although the FOG has been eliminated to under the detection limits after the treatment, and before the treatment, SDI were not detected, the code of effluent or influent should not delete it, in order to better show the initial conditions, requirements and effects of the treatment. The bidder from across the world can then decode the codes, get the detailed information about the in/effluent, and choose suitable treatment and reuse tech to meet the requirements for one or several quality parameters, and design a reasonable processing procedure. With the general coding system,

42 characters can show the classification and water quality of certain wastewater, which largely facilitate the commercial communication.

A.2 The usage in everyday performance for maintenance department of wastewater reuse

Not only the communication department will benefit from this document, the daily operation and design departments will also save plenty of time when applying this classification and coding system. For example, in a pilot plant treating wastewater for the purpose of reuse in a second steel plant, a sand filtration unit and an electrodialysis reversal unit which has a daily treatment capacity of 350 m^3 per day[22] were installed, and the daily water quality of in/effluent was recorded. Table A.2[22] illustrates everyday performance of wastewater treatment for water reuse. Through coding, everyday performance can be easily shared within maintenance department.

Table A.2 — Code and value of industrial reuse wastewater parameters in a steel plant

Code	**Category name**								
RB	**Basic iron and steel manufacturing wastewater**								
Code	**Water quality parameter**	**Wastewater influent**	**Reuse water effluent**	**Day 7 influent**	**Day 7 effluent**	**Day 15 influent**	**Day 15 effluent**	**Day 20 influent**	**Day 20 effluent**
AD	EC	3 860	305	4 695	275	4 085	269	3 511	325
FF	Calcium	166	1,4	99	1,0	149	0,9	195	0,9
BI	COD	41	20	40	19	36	20	28	17
DD	Chloridion	888	13	1 098	15	1 063	11	735	19
DB	Sulfate	437	86	443	89	469	67	465	88
Codes for each day		RBAD43-BI41-DB42-DD92-FF22	RBAD32-BI21-DB91-DD11-FF10	RBAD53-BI41-DB42-DD11-FF12	RBAD32-BI21-DB91-DD21-FF10	RBAD43-BI41-DB52-DD13-FF12	RBAD32-BI21-DB71-DD11-FF9a	RBAD43-BI31-DB52-DD72-FF22	RBAD32-BI21-DB91-DD21-FF9a
NOTE The water qualities of all the monitored parameters of the reuse water effluent were better than city water quality, see Reference [22].									

As above, although both plants are in the same industry, the parameter of water reuse and treatment systems can be chosen specifically to meet the different requirements of users.

A.3 The usage in making or updating standards and laws for wastewater reuse by decision makers

For decision makers as the governments and large corporations, a more important usage of the classification and coding system is for helping to establish or improve the standards of discharge and reuse of industrial wastewater. This classification and coding system is especially helpful when dealing with analysis of large amount of data from different plants. For instance, although the above two plants apply different water quality parameters according to their own situation, electrical conductivity (AD) and chloridion (DD) are included by both, thus, it's reasonable that through the investigation of a large amount of the data upload by different plants, a summary of most frequently appeared parameters in a specific industry can be concluded, and applied for further draft standards of wastewater reuse or discharge for this industry, namely when the government calls for data collection of wastewater from textile industry (HA-HJ), all plants (e.g. 100) with wastewater code started with H must upload their data. The codes uploaded are listed in Table A.3.

Table A.3 — Codes of wastewater uploaded into reuse treatment system by textile industry plants

Code	Category name		
HA	textiles manufacturing wastewater		
Effluent Code	HBAB10-AD52-BI33	HAAA49-AB92-AD72-BA08-BI23	HAAA59-AB93-AD33-BI84
	HBAB40-AD52-BA06-BI34	HAAA24-AB43-AD63-BA07-BI15	HAAA28-AB33-AD82-BI65
	HCAB43-AD42-BA07-BI64	HAAA57-AB31-AD42-BA09-BI23	HAAA57-AB71-AD82-BA08-BI13
	HCAB72-AD82-BA09-BI94	HAAA40-AB60-AD73-BA06-BI94	HAAA27-AB40-AD33-BA08-BI25
	HCAB50-AD53-BA08-BI34	HAAA45-AB91-AD72-BA06-BI95	HAAA54-AB81-AD62-BA06-BI73
	HCAB70-AD42-BA07-BI55	HAAA42-AB50-BA06-BI95	HAAA38-AB51-AD73-BA08-BI23
	HCAA33-AB72-AD73-BA06-BI25	HAAA59-AB21-BA07-BI13	HAAA40-AB41-AD32-BA9-BI64
	HCAA33-AB13-BA07-BI83	HAAA49-AB81-BA06-BI34	HAAB83-AD42-BA09-BI94
	HCAA45-AB93-BA06-BI94	HAAA59-AB43-BA06-BI55	HAAB31-AD82-BA07-BI44
	HCAA26-AB60-BA07-BI34	HAAA50-AB72-BI25	HAAB12-BA09-BI75
	HCAA36-AB30-AD43-BA06-BI23	HAAA24-AB81-BI64	HBAB50-BA09-BI83
	HCAB63-AD52-BA06-BI43	HAAA46-AB51-BI15	HBAA40-AB20-BA08-BI75
	HCAB30-AD62-BA06-BI43	HAAA58-AB91-BI63	HBAA37-AB42-BA09-BI93
	HDAB13-AD83-BA09-BI75	HAAA50-AB10-BI35	HBAA29-AB73-BA09-BI23
	HDAB62-AD33-BA06-BI65	HAAA34-AB71-AD53-BI55	HBAA54-AB13-AD73-BA09-BI55
	HDAB90-AD33-BA08-BI34	HAAA27-AB20-AD53-BI93	HBAA44-AB31-AD33-BA09-BI93
	HDAB91-AD32-BA09-BI94	HAAA49-AB53-AD73-BI15	HBAA41-AB41-AD72-BA08-BI65
	HDAA32-AB50-AD62-BI54	HAAA21-AB11-AD53-BI15	HDAA60-AB63-BI84
	HDAA50-AB73-AD33-BI63	HBAA45-AB62-AD83-BA06-BI13	HEAA52-AB33-BA06-BI15
	HDAA34-AB73-AD43-BI15	HBAA47-AB10-AD32-BI64	HEAA51-AB43-BA08-BI35
	HDAA54-AB62-AD73-BI34	HBAB80-AD53-BI43	HEAA28-AB31-BA08-BI63
	HEAA51-AB13-AD43-BA09-BI65	HBAB90-AD32-BI44	HEAA42-AB82-BA08-BI33
	HEAA54-AB51-AD72-BA09-BI13	HBAB33-AD63-BI93	HEAA47-AB90-BA06-BI63
	HEAA57-AB93-AD63-BA09-BI45	HBAB90-AD62-BI13	HEAA30-AB72-AD52-BA08-BI44
	HFAB90-BI94	HBAB42-AD82-BI44	HEAB81-AD72-BI75
	HFAB93-BI25	HBAB50-AD53-BI23	HEAB60-AD52-BI45
	HFAA57-AB72-BA09-BI14	HEAB31-BI24	HEAB63-AD52-BI24
	HFAB90-AD73-BI14	HEAB33-BI95	HFAA33-AB21-BA09-BI13
	HGAB60-AD42-BI33	HFAB93-BI75	HFAA27-AB61-AD72-BA08-BI23
	HGAB63-BI83	HGAB83-BI24	HFAA37-AB53-AD52-BA07-BI35
	HHAA27-AB93-BA09-BI34	HGAA37-AB72-BI24	HFAB13-AD73-BA09-BI34
	HHAA59-AB70-BA07-BI94	HGAA36-AB22-BI94	HIAA36-AB82-BA08-BI15
	HJAA48-AB23-AD73-BA06-BI55	HGAB23-BI45	HIAA44-AB12-AD73-BA08-BI64
		HHAB61-BA06-BI25	

NOTE The value of each water quality parameters is randomly simulated according to published studies and projects experience, see References [22] to [24].

Among the codes provided, COD-BI (100 %), and colour-AB (100 %) are the most frequently required parameters, electrical conductivity-AD (60 %), pH-BA (60 %) and temperature-AA (62 %) are also frequently required, then the government can set the COD-AD and colour-AB as mandatory parameters in textile industrial wastewater reuse, while temperature-AA, electrical conductivity-AD and pH-BA as optional parameters. In addition, with the values provided in the code, even a brief evaluation for the potential improvement can be achieved more easily, for example, when the data of a water quality parameter from the same industrial type are collected: 70 % plants meet the value range while 30 %

plants cannot meet this range, governments or large corporations as decision makers can know the overall situation and may push those 30 % plants to improve their performance to meet this value range.

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