Comparison of the best available technique indicators for processing animal tissues

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ABSTRACT: A method comparing the technologies used in the industry processing animal tissues with the best available techniques (BAT) based on the principle of an integrated pollution prevention and control (IPPC) is suggested. The method compares individual mutually comparable BAT indicators expressed by quantities indicating the standard of the method compared in relation to BAT. The method can be applied to compare the environmental standard of the equipment to which the Act No. 76/2002 Dig. of the relevant production branch relates.

Keywords: IPPC; BAT; rendering plant; environmental standard

The procedure of a rendering-plant processing of wastes of animal origin is energy consuming being caused in particular by strict requirements for sterilizing (holding a high temperature of min. 133°C and pressure – of at least 0.3 MPa for min. 20 minutes in harmony with the Decree of the Ministry of Agriculture (MZe) No. 399/2001 Dig.) and a low efficiency of suitable recuperation equipment. From the environmental point of view also the rate and degree of sewage contamination and air pollution with bad-odour emissions is of importance.A non-negligible burden is the operation of vehicles collecting and transporting animal wastes, too.

In addition to the above indices a number of other effects on environment must be taken into account when comparing the environmental and technical standard as well as the effectivity of veterinary decontamination institutes (VAÚ) and their individual technological sections.

Besides environmental factors it is always necessary to pay regard to the economic availability of the techniques, which is another important factor in determining their suitability, in particular if they are to be applied to operation.

When defining environmental and technical standard of individual techniques applied their comparison with the so-called Best Available Techniques (BAT) is presumed based on the demands of the Directive 96/61/EC on Integrated Pollution Prevention and Control incorporated into the Czech legal system by the Act No. 76/2002 Dig. on Integrated Prevention Pollution and Control, on Integrated Pollution Record and on Amendments of some Acts (Act on IPPC). Complete lists of BAT techniques are issued by the European Commission as the so-called Best Available Techniques Reference Documents (BREFs) separately for individual branches of industry and agriculture. The Draft Reference Document on Best Available Techniques in the Slaughterhouses and Animal By-products Industries (2003) corresponds with the VAÚ problems.

The suggested comparison method presumes a calculation of arithmetic means of the individual mutually comparable indicator relations of the applied and reference technique. The indicators are expressed in quantities comparable with relevant specific units related to 1 ton of the raw material processed.

METHODS

For comparing individual techniques applied the following indicators are defined:

– For energy consumption MAREČEK et al. (2002) suggest a general indicator W_i.

The indicators are classified based on energy sources:

– electric power (W_e),
– natural gas (W_{ng}),
– biogas (W_{bg}),
– light fuel oil (W_{LTO}),
– heavy fuel oil (W_{TTO}),
– rendering-plant fat (W_{rf}),
– biomass (W_b),
– meat and bone meal (W_{MBM}),
– solid fossil fuel (Ws_{ff}),
– classified combustible waste (W_{ccw}),
– propellants (W_{PHM}).

The indicator W_i is then the consumption of individual sorts of energy related to a unit of the raw material processed expressed in relevant units – for instance (kWh/t, GJ/t).

– For water consumption the V_i indicator is suggested.

The indicators differ depending on the water sort used (drinking or service water):

– drinking water (V_d),

Worked out in harmony with the Mendel University of Agriculture and Forestry Brno intention No. MSM 432100001.

– service water (V_s).

The V_i indicator is then expressed in cu. m of water consumed for processing 1 ton of the inlet raw material (m^3/t).

– For gaseous emissions let us suggest the G_i indicator.

The indicators differ based on the following pollutants:

– SO_2 (G_{SO}),
– NO_X (G_{NO}),
– CO_2 (G_{CO_2}),
– CO (G_{CO}),
– H_2S (G_{HS}),
– volatile organic compound (G_{VOC}),
– CxHy (G_{CH}),
– NH_3 (G_{NH}),
– bad-odour emissions (G_{od}).

The G_i indicator will be expressed in grams of the relevant pollutant per 1 ton of the inlet raw material (g/t). Bad-odour emissions can be expressed in specific units with difficulty only and for this reason they are compared e.g. by means of the unit values of the bad-odours exhausted by the processing method (OU) to the air.

– For water pollutants let us suggest the indicator L_i.

The indicators are classified based on their measurable pollution indices:

– chemical oxygen demand – COD (L_{COD}),
– biochemical oxygen demand after 5 days – BOD_5 (L_{BOD}),
– total suspended solids (L_{TSS}),
– soluble anorganic salts (L_{RAS}),
– $N\text{-}NH_4^+$ (L_{NH}),
– P (L_P).

The indicator L_i will be expressed in grams of the pollutant per 1 ton of the raw material processed (g/t).

– For solid wastes let us suggest the indicator S_i.

The indicators are classified based on dangerous properties of wastes:

– hazardeous (S_h),
– non-hazardeous (S_n).

The indicator S_i will be expressed in grams or kilograms of the waste per 1 ton of the raw material processed (g/t; kg/t).

– For the cost of individual technologies let us suggest the indicator C_i.

The indicators differ based on their:

– purchase cost (C_p),
– operational cost (C_o).

The indicator C_i will be expressed in units of the relevant currency per 1 ton of the raw material processed: (CZK/t; €/t).

RESULTS

When comparing the techniques applied with BAT it is necessary to compare gradually individual mutually comparable indicators. For this purpose the relations given below (1) are suggested which relate individual mutually comparable indicators to one another expressing their arithmetic mean designated as x with a subscript corresponding with individual indicators.

$$x_W = \frac{\sum_{i=1}^{n} \frac{{}^{P}W_i}{{}^{R}W_i}}{n} \qquad x_V = \frac{\sum_{i=1}^{n} \frac{{}^{P}V_i}{{}^{R}V_i}}{n} \qquad x_G = \frac{\sum_{i=1}^{n} \frac{{}^{P}G_i}{{}^{R}G_i}}{n}$$

$$x_L = \frac{\sum_{i=1}^{n} \frac{{}^{P}L_i}{{}^{R}L_i}}{n} \qquad x_S = \frac{\sum_{i=1}^{n} \frac{{}^{P}S_i}{{}^{R}S_i}}{n} \qquad x_C = \frac{\sum_{i=1}^{n} \frac{{}^{P}C_i}{{}^{R}C_i}}{n} \qquad (1)$$

where: the LH superscript P indicates the technology compared and the LH superscript R the reference technology, the quantity n indicating the number of the indicators compared.

All the indicators can be compared by means of the following relation (2), expressing the resulting arithmetic mean of all indicator relations traced.

$$x = \frac{x_W + x_V + x_G + x_L + x_S + x_C}{6} \qquad (2)$$

The relation can be expressed as follows (3):

$$x = \frac{\sum_{i=1}^{n} \frac{{}^{P}indicator_i}{{}^{R}indicator_i}}{n} \qquad (3)$$

The resulting value x defines the standard of the technique compared with BAT. The lower the resulting coefficient, the more environment-friendly is the technique compared.

If the resulting value equals $x < 1$, the technique compared based on the traced indicators is environmentally and technically more advanced than the reference technique.

If the resulting value equals $x > 1$, the technique compared based on the traced indicators is environmentally and technically less advanced than the reference technique.

If the resulting value equals $x = 1$, the technique compared based on the traced indicators is as advanced as the reference technique.

With respect to the existing differences in the significance of individual indicators due to their effect on environment it may be better to use a weighted form of the arithmetic mean for their comparison. Then (4)

$$x = \frac{\sum_{i=1}^{k} \frac{{}^{P}indicator_i}{{}^{R}indicator_i} \cdot n_i}{n} \qquad (4)$$

where: n_i of individual indicators is of the value defined based on the importance of relevant indicators of the technique compared and its effect on environment. The n value is then the sum of all partial n_i. The quantity k is the number of the indicators compared.

The resulting value is evaluated similarly to the simple arithmetic mean.

CONCLUSION

The method suggested enables to compare the standard of the techniques applied with BAT for the VAÚ production process. The arithmetic mean of the mutually comparable indicator relations is used both in its simple and weighted form. In case of the weighted form it is first necessary to determine the n_i values based on the significance of the indicators compared with respect to their technology. The result of the method suggested is an exactly computed comparable value expressing the environmental and technical standard of the technique compared with the reference technique. In this way it is possible to compare the equipment to which the Act No. 76/2002 Dig. relates and to choose subsequently the most advanced and most environment-friendly technique.

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Vyhláška Ministerstva zemědělství č. 399/2001 Sb., kterou se mění vyhláška Ministerstva zemědělství č. 286/1999 Sb., kterou se provádějí ustanovení zákona č. 166/1999 Sb., o veterinární péči a o změně některých souvisejících zákonů (veterinární zákon), o zdraví zvířat a jeho ochraně, o veterinárních podmínkách dovozu, vývozu a tranzitu veterinárního zboží, o veterinární asanaci a o atestačním studiu.

Zákon č. 76/2002 Sb. o integrované prevenci a omezování znečištění, o integrovaném registru znečišťování a o změně některých zákonů.

Received for publication February 11, 2004

Accepted after corrections March 11, 2004

Porovnání indikátorů nejlepších dostupných technik pro zpracování živočišných tkání

ABSTRAKT: Je navržena metodika pro porovnání technologií používaných v průmyslu ke zpracování živočišných tkání s nejlepšími dostupnými technikami (BAT), vycházejícími z principu integrované prevence a omezování znečištění (IPPC). Metodika porovnává jednotlivé vzájemně porovnatelné indikátory BAT a uvádí vyjádření veličiny, která udává úroveň porovnávané techniky vzhledem k BAT. Metodiku je možné použít pro porovnání environmentální úrovně zařízení dotčených Zákonem č. 76/2002 Sb. příslušného výrobního odvětví.

Klíčová slova: IPPC; BAT; kafilerie; environmentální úroveň

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