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університет****УДК 621.43:662.75****DOI: 10.37128/2306-8744-2026-3-17****MODELLING THE EFFECT OF
BLENDED FUEL CONTAMINATION
ON FILTRATION PARAMETERS IN
A DIESEL ENGINE FUEL SUPPLY
SYSTEM**

This paper examines the effects of particulate contaminants, biofuel fraction and blended fuel temperature on the hydraulic parameters of filtration in a diesel engine fuel supply system. The aim is to substantiate a calculation approach for determining pressure drop and filter operating time to a specified limiting value, accounting for retained particle accumulation. The methodology combines a contaminant mass balance with a model of the resistances of the clean filter medium and the cake in series at a constant volumetric fuel flow rate. Analytical relationships are obtained for calculating pressure drop, limiting retained contaminant mass, time to the specified pressure drop and minimum effective filtration area. Calculations are performed for biofuel volume fractions of 0, 15 and 30%, temperatures of 20–40 °C and particulate contaminant concentrations of 5–20 mg/L. In the baseline calculation example, at a flow rate of 100 L/h and a filtration area of 0.050 m², increasing contaminant concentration from 5 to 20 mg/L reduces the time to a pressure drop of 30 kPa from 39.47 to 9.87 h. Under the assumed relationship between viscosity and fuel composition, increasing the biofuel fraction from 0 to 30% at 20 °C reduces this time by 31.8%. To provide a calculated filtration time of 20 h at a contaminant concentration of 10 mg/L, the required area is 0.0503 m² for B0 and 0.0595 m² for B30. A normalised additional resistance index is proposed, which, within the adopted model, makes it possible to separate the effect of contaminant accumulation from the direct effects of fuel viscosity and flow rate. Local sensitivity coefficients of the calculated time to the principal parameters are determined. For the baseline conditions, the sensitivity coefficients with respect to flow rate and filtration area are –2.20 and 2.20, respectively, confirming the need to account accurately for these quantities when assessing filter condition. The numerical results are obtained by analytical calculation using specified parameters; no experimental validation of a specific filter is performed within this study. The practical significance of the proposed relationships lies in their potential use for test planning, preliminary selection of filtration area and substantiation of parameters for a fuel filter condition monitoring system. Application of the model to a specific fuel supply system requires determination of its coefficients from measurements and validation of the predicted time to the limiting pressure drop.

Keywords: fuel system, fuel supply system, petroleum products, biofuel, biodiesel, fuel quality monitoring, quality control systems.

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Introduction. The use of blended fuel in diesel engines requires its properties to be matched to the fuel supply system parameters. In this paper, biofuel means a liquid ester-type fuel added to

petroleum diesel. B15 and B30 denote biofuel volume fractions of 15 and 30%, respectively, while B0 denotes the baseline diesel fuel. These fractions

are calculation levels and do not imply approval of the blends for any particular engine.

Fuel filter condition is affected by both solid contaminants entering with the fuel and changes in fuel properties. The biodiesel handling and use guide [1] discusses deposit formation, temperature effects and material compatibility. Differential pressure readings should therefore be analysed together with the conditions under which fuel passes through the filter element.

Two distinct characteristics are essential to a fuel supply system: particle retention capability and resistance to flow. A lower pressure drop alone does not demonstrate improved cleaning. Likewise, a higher pressure drop does not uniquely determine the accumulated contaminant mass unless flow rate and viscosity are accounted for. This paper focuses on the hydraulic aspect of filtration at a specified contaminant retention efficiency.

Studies published in Ukrainian provide further context for the problem. Riaboshapka [2] systematised research directions for the transition of diesel engines to biofuels and proposed staged testing of alternative fuels. Halushchak et al. [3] considered the effects of blended fuel component temperature on fuel delivery and engine operation. Their work concerned blends with vegetable oils; its numerical results are therefore not transferred to the ester-type biofuel blends considered here. Study [4] proposed a method for determining diesel–biodiesel blend composition according to driving conditions and vehicle load. For filtration analysis, these studies highlight the need to account for temperature and component composition when assessing the hydraulic condition of a filter.

Review of recent research and publications. Thangamani et al. [5] combined testing and modelling of the effects of fuel blends on a filter. For the biofuels studied, they reported an increased pressure drop and considered changes in temperature and filtration area as ways to reduce it. These findings support the joint analysis of fuel properties and filter geometry.

Paryanto et al. [6] related precipitate formation in B20 to filter clogging time. Their procedure assessed the limiting condition by a pressure drop of 30 kPa. Pramudito et al. [7] investigated B30 and B40 filterability for different filter element characteristics. These studies show that fuel blends should be compared under consistent test conditions.

Haryono et al. [8] examined the combined effects of temperature, contaminants and precipitate formation on fuel filter lifetime. Chib and Sharma Dugala [9] compared blocking tendencies and changes in filter material properties in contact with different blends. Clogging mechanisms thus depend on fuel origin and contaminant type, and a

single concentration relationship cannot describe every case.

Constant flow rate cake filtration studies [10] provide the physical basis for expressing pressure drop in terms of the resistances of the medium and retained particles. However, cake parameters cannot be transferred directly between different liquids and dispersed systems. They require separate determination for a fuel filter.

The available findings are used to formulate an applied problem: to derive a transparent calculation framework linking contaminant concentration, viscosity, flow rate and filtration area to the time required to reach a specified pressure drop limit. The contribution of this work is the systematic derivation of relationships for scenario analysis and a normalised resistance index; the general filtration law is not presented as a new physical law.

Research objective. To substantiate a calculation approach for assessing the effects of blended fuel contamination on pressure drop and filter operating time to a specified limit, accounting for biofuel fraction, temperature and filtration area.

Materials and methods. The object of the study is the passage of blended fuel containing particulate contaminants through a filter element. The study examines relationships between hydraulic resistance, retained particle mass and operating parameters. Analytical modelling, scenario calculations and sensitivity analysis are employed. No original bench measurements were performed for this paper.

The model assumes single-phase Newtonian fuel, laminar flow through a porous medium, uniform flow distribution and an incompressible cake. Flow rate Q , concentration C and mass-based retention efficiency η are constant. The model represents single-pass flow or a test with controlled inlet concentration. The assumption $C = \text{const}$ is unsuitable for a recirculating tank without contaminant dosing.

$$m(t) = \eta C Q t \quad (1)$$

where m is retained contaminant mass, kg; C is contaminant mass per unit fuel volume, kg/m³; Q is volumetric flow rate, m³/s; t is time, s; and η is mass-based retention efficiency expressed as a fraction. The initial condition is $m(0) = 0$. Values of C in mg/L are converted to kg/m³ by multiplying by 10⁻³.

$$\Delta p = \frac{\mu Q}{A} (R_m + R_c) \quad (2)$$

$$R_c = \alpha m / A.$$

where Δp is the pressure drop across the filter, Pa; μ is dynamic viscosity, Pa·s; Q is volumetric flow rate, m³/s; A is effective filtration area, m²; R_m is clean medium resistance, m⁻¹; R_c is cake resistance, m⁻¹; α is specific cake resistance,

m/kg; and m is retained contaminant mass, kg. A resistances-in-series model is used [10]. Here, A is the area of the medium through which fuel flows, rather than the housing cross-sectional area.

$$\Delta p(t) = \Delta p_0 + kt \quad (3)$$

$$\Delta p_0 = \frac{\mu Q R_m}{A}, \quad k = \frac{\mu \alpha \eta C Q^2}{A^2}$$

where $\Delta p(t)$ is pressure drop at time t , Pa; Δp_0 is the initial pressure drop across the clean filter, Pa; k is the rate of pressure drop increase, Pa/s; t is filtration time, s; μ is dynamic viscosity, Pa·s; Q is volumetric flow rate, m³/s; R_m is clean medium resistance, m⁻¹; A is effective filtration area, m²; α is specific cake resistance, m/kg; η is mass-based retention efficiency, dimensionless; and C is contaminant mass per unit fuel volume, kg/m³.

The linear increase in pressure drop follows from the assumption of constant parameters. If the cake compresses, particles block pores or flow rate varies, the curve may become nonlinear and require a different model closure.

$$\mu(b, T) = \mu_0(1 + a_b b) \exp[-\gamma(T - T_0)] \quad (4)$$

where b is biofuel volume fraction, dimensionless; T is fuel temperature, °C; T_0 is reference temperature, °C; $\mu(b, T)$ is blended fuel dynamic viscosity at b and T , Pa·s; μ_0 is B0 dynamic viscosity at T_0 , Pa·s; a_b is a dimensionless composition coefficient; and γ is the temperature coefficient, K⁻¹. The temperature difference $T - T_0$ has the same numerical value in kelvins and degrees Celsius. For the numerical example, Eq. (4) is prescribed as a scenario approximation. This relationship is not fitted to original experimental data. Coefficient values are given in Table 1; for a different fuel, they should be determined from measurements.

$$t_{cr} = \frac{(\Delta p_{cr} - \Delta p_0) A^2}{\mu \alpha \eta C Q^2} \quad (5)$$

where t_{cr} is time to the specified limiting pressure drop, s; Δp_{cr} is the specified limiting pressure drop, Pa; Δp_0 is the initial pressure drop across the clean filter, Pa; A is effective filtration area, m²; μ is dynamic viscosity, Pa·s; α is specific cake resistance, m/kg; η is mass-based retention efficiency, dimensionless; C is contaminant mass per unit fuel volume, kg/m³; and Q is volumetric flow rate, m³/s.

If $\Delta p_{cr} \leq \Delta p_0$, t_{cr} is set to zero: the clean element already fails to meet the specified hydraulic condition. If $C = 0$ and no other clogging mechanisms are present, the model predicts no finite time to the limit.

$$m_{cr} = \frac{A}{\alpha} \left(\frac{\Delta p_{cr} A}{\mu Q} - R_m \right) \quad (6)$$

where m_{cr} is retained contaminant mass at the specified limiting pressure drop, kg; A is effective filtration area, m²; α is specific cake resistance, m/kg; Δp_{cr} is the specified limiting pressure drop, Pa; μ is dynamic viscosity, Pa·s; Q is volumetric flow rate, m³/s; and R_m is clean medium resistance, m⁻¹.

The limiting mass m_{cr} describes the attainment of a specified pressure drop at particular values of μ and Q . It should not be equated with a constant rated dirt-holding capacity of the filter.

$$I_r = \frac{A \Delta p}{\mu Q R_m} - 1 = \frac{\alpha m}{A R_m} \quad (7)$$

where I_r is the normalised additional resistance index, dimensionless; A is effective filtration area, m²; Δp is pressure drop across the filter, Pa; μ is dynamic viscosity, Pa·s; Q is volumetric flow rate, m³/s; R_m is clean medium resistance, m⁻¹; α is specific cake resistance, m/kg; and m is retained contaminant mass, kg.

The index I_r expresses additional resistance relative to that of the clean medium. Within the model, it removes the direct effects of μ and Q but does not identify contaminant composition. Its calculation requires measured flow rate and temperature, together with a justified viscosity estimate.

$$A_{min} = \frac{\mu Q R_m + \sqrt{D}}{2 \Delta p_{cr}} \quad (8)$$

$$D = (\mu Q R_m)^2 + 4 \Delta p_{cr} \mu \alpha \eta C Q^2 t_{req}$$

where A_{min} is the minimum effective filtration area, m²; μ is dynamic viscosity, Pa·s; Q is volumetric flow rate, m³/s; R_m is clean medium resistance, m⁻¹; Δp_{cr} is the specified limiting pressure drop, Pa; D is the auxiliary discriminant, Pa²·m⁴; α is specific cake resistance, m/kg; η is mass-based retention efficiency, dimensionless; C is contaminant mass per unit fuel volume, kg/m³; and t_{req} is the required filtration time, s.

Equation (8) is obtained by solving the inequality $\Delta p(t_{req}) \leq \Delta p_{cr}$ for A , where t_{req} is the required filtration time. The expression applies to constant R_m and α and uniformly utilised area. It does not account for losses in the housing or fuel lines.

Input data and calculation scheme. The input quantities are listed in Table 1. All numerical filter parameters and viscosity relationship coefficients are assumptions of the calculation scenario. The illustrative limit of 30 kPa is selected by analogy with the criterion in study [6]; it is not a universal filter replacement requirement for diesel engines.

Table 1
Assumed scenario calculation parameters

Parameter	Value	Unit
Biofuel fraction b	0; 0.15; 0.30	Volume fraction
Temperature T	20; 30; 40	°C
Contaminant concentration C	5; 10; 20	mg/L
Flow rate Q	100 ($2.778 \cdot 10^{-5}$)	L/h (m^3/s)
Filtration area A	0.050	m^2
Clean medium resistance R_m	$3.0 \cdot 10^9$	m^{-1}
Specific cake resistance α	$4.0 \cdot 10^{10}$	m/kg
Mass-based efficiency η	0.95	Fraction
Reference viscosity μ_0 at $T_0 = 20$ °C	$3.0 \cdot 10^{-3}$	$\text{Pa} \cdot \text{s}$
Coefficients a_b ; γ	1.20; 0.025	1; K^{-1}
Assumed pressure drop limit Δp_{cr}	30	kPa

A constant mass-based efficiency of $\eta = 0.95$ is introduced to isolate hydraulic effects. It is neither a measured value nor a specification of a particular filtration rating. In engineering practice,

particle-count efficiency is determined for a specified particle size using the β -ratio [11]. This quantity cannot automatically replace mass-based η without information on the particle distribution.

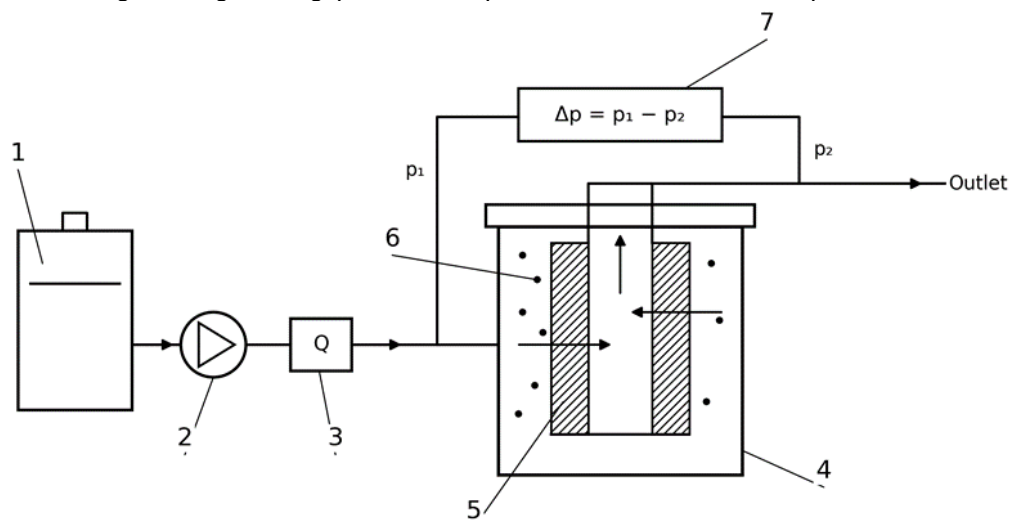


Fig. 1. Calculation schematic for blended fuel filtration: 1 — blended fuel tank; 2 — fuel feed pump; 3 — flowmeter; 4 — filter housing; 5 — filter element; 6 — particulate contaminants; 7 — differential pressure sensor; p_1 and p_2 — pressures upstream and downstream of the filter.

Figure 1 shows an arrangement that could be used to validate the model; it does not depict a constructed test rig. Pressure taps are positioned close to the filter to minimise the influence of line losses. Temperature and concentration are prescribed at the inlet, and flow rate is maintained constant until the selected limit is reached.

For the selected b and T levels, crystallisation, a free water phase and new precipitate formation during passage through the filter are assumed absent. Biofuel effects are

therefore represented solely through viscosity. Ageing, precipitation and water separation are not included in this model; additional state variables would be required if these processes occurred.

Results and discussion. Fuel property effects are first evaluated at fixed $C = 10$ mg/L, $Q = 100$ L/h and $A = 0.050$ m^2 . Table 2 gives calculated values for nine combinations of biofuel fraction and temperature. Pressure drop after 10 h is reported only for conditions in which the specified limit has not yet been reached.

Table 2

Effects of biofuel fraction and temperature ($C = 10 \text{ mg/L}$)

Blend	T, °C	μ , mPa·s	Δp_0 , kPa	$\Delta p(10 \text{ h})$, kPa	t_{cr} , h
B0	20	3.000	5.00	17.67	19.74
B0	30	2.336	3.89	13.76	26.46
B0	40	1.820	3.03	10.72	35.10
B15	20	3.540	5.90	20.85	16.12
B15	30	2.757	4.59	16.24	21.82
B15	40	2.147	3.58	12.64	29.14
B30	20	4.080	6.80	24.03	13.47
B30	30	3.178	5.30	18.71	18.41
B30	40	2.475	4.12	14.57	24.76

At $T = 20^\circ\text{C}$, changing from B0 to B30 in the assumed scenario increases viscosity from 3.000 to 4.080 mPa·s, initial pressure drop from 5.00 to 6.80 kPa, and pressure drop after 10 h from 17.67 to 24.03 kPa. Accordingly, t_{cr} decreases from 19.74 to 13.47 h, or by 31.8%. These differences follow from the prescribed Eq. (4), rather than a demonstrated universal effect of all biofuels.

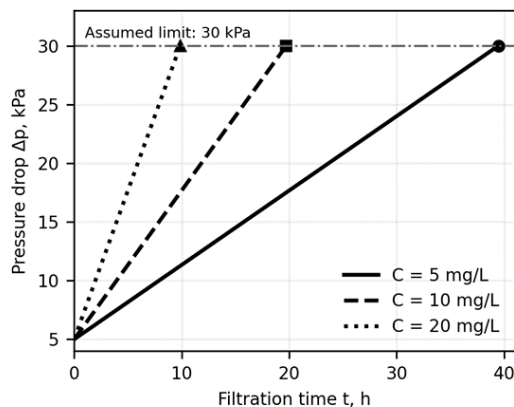


Fig. 2. Calculated pressure drop evolution for B0 at $T = 20^\circ\text{C}$

The initial value in Fig. 2 is 5 kPa because the clean filter medium already offers resistance. At $C = 5, 10$ and 20 mg/L , the rates of pressure drop increase are 0.633, 1.267 and 2.533 kPa/h, respectively. The curves terminate at 30 kPa; operation beyond this limit was not modelled.

Under baseline conditions, the retained contaminant mass after 10 h is $m = 0.95 \cdot 0.010 \cdot 0.100 \cdot 10 = 0.0095 \text{ kg}$, or 9.5 g. The additional resistance is $7.60 \cdot 10^9 \text{ m}^{-1}$ and contributes 12.67 kPa to the pressure drop. Adding the initial 5.00 kPa gives 17.67 kPa, consistent with direct calculation using Eq. (3).

Time to the pressure drop limit and effects of contamination. Temperature is fixed at 20°C to evaluate particulate contaminant effects. The results in Table 3 and Fig. 3 are obtained with unchanged filter parameters. The calculated t_{cr} represents only the attainment of the hydraulic limit; it is not a recommended service interval.

Table 3

Time to $\Delta p_{cr} = 30 \text{ kPa}$ at $T = 20^\circ\text{C}$

C, mg/L	B0: t_{cr} , h	B15: t_{cr} , h	B30: t_{cr} , h
5	39.47	32.25	26.93
10	19.74	16.12	13.47
20	9.87	8.06	6.73

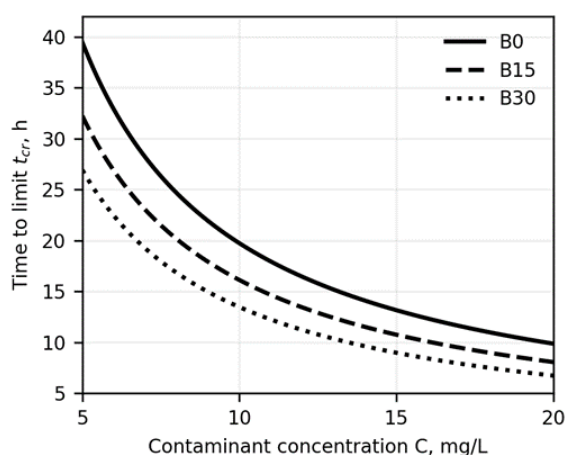


Fig. 3. Calculated time to the pressure drop limit versus contaminant concentration

In the adopted model, t_{cr} is inversely proportional to concentration. For B0, increasing C from 5 to 20 mg/L reduces this time from 39.47 to 9.87 h. The corresponding values for B30 are 26.93 and 6.73 h. This fourfold reduction follows directly from the mass balance at constant mass-based retention efficiency.

For B0 at $C = 10$ mg/L, the limiting contaminant mass is 18.75 g, compared with 12.79 g for B30 at the same temperature. The difference arises because higher viscosity causes the specified pressure limit to be reached at a lower additional resistance. Thus, the same Δp_{cr} does not correspond to equal contaminant accumulation at different viscosities.

At fixed b and C , increasing temperature from 20 to 40 °C increases the calculated t_{cr} from 19.74 to 35.10 h for B0 and from 13.47 to 24.76 h for B30. This is a hydraulic consequence of the assumed temperature dependence of viscosity. It does not account for possible changes in deposit solubility, cleaning efficiency or filter material.

Using Eq. (8) for a required time $t_{req} = 20$ h, $C = 10$ mg/L and $T = 20$ °C gives $A_{min} = 0.0503$ m² for B0 and 0.0595 m² for B30. With other conditions unchanged, this scenario therefore requires an increase in effective area of approximately 18.4%. Applying the estimate to a design requires consideration of available pleat area, nonuniform flow and additional losses.

Sensitivity assessment and monitoring potential. The local analysis uses the dimensionless coefficient $S_x = \partial \ln(t_{cr}) / \partial \ln(x)$, which describes the relative change in t_{cr} caused by a small relative change in parameter x . The derivatives are obtained from Eq. (5) with all other parameters held constant.

$$S_C = S_\alpha = S_\eta = -1 \quad (9)$$

where S_C , S_α and S_η are dimensionless local sensitivity coefficients of t_{cr} with respect to contaminant concentration C , specific cake

resistance α and mass-based retention efficiency η , respectively; t_{cr} is time to the specified limiting pressure drop, s; C is expressed in kg/m³, α in m/kg, and η is dimensionless.

$$S_\mu = -\frac{\Delta p_{cr}}{\Delta p_{cr} - \Delta p_0} \quad (10)$$

where S_μ is the dimensionless local sensitivity coefficient of t_{cr} with respect to dynamic viscosity μ ; t_{cr} is time to the specified limiting pressure drop, s; μ is expressed in Pa·s; Δp_{cr} is the specified limiting pressure drop, Pa; and Δp_0 is the initial pressure drop across the clean filter, Pa.

$$S_Q = -\frac{2\Delta p_{cr} - \Delta p_0}{\Delta p_{cr} - \Delta p_0}, \quad S_A = -S_Q \quad (11)$$

where S_Q and S_A are dimensionless local sensitivity coefficients of t_{cr} with respect to volumetric flow rate Q and effective filtration area A , respectively; t_{cr} is time to the specified limiting pressure drop, s; Q is expressed in m³/s and A in m²; Δp_{cr} is the specified limiting pressure drop, Pa; and Δp_0 is the initial pressure drop across the clean filter, Pa.

For the baseline conditions $\Delta p_0 = 5$ kPa and $\Delta p_{cr} = 30$ kPa, the coefficients are $S_\mu = -1.20$, $S_Q = -2.20$ and $S_A = 2.20$. Thus, a 1% flow rate error locally corresponds to an approximately 2.2% change in predicted time. Sensitivity rises sharply as Δp_0 approaches Δp_{cr} , making the time estimate unstable with respect to input errors.

A scenario-based uncertainty check for α shows that a -20% change increases the baseline t_{cr} from 19.74 to 24.67 h, whereas a +20% change reduces it to 16.45 h. This range results from an assumed parameter variation and should not be interpreted as a statistical confidence interval.

After 10 h for B0 at 20 °C, $I_r = 17.67/5.00 - 1 = 2.53$. If temperature rises to 40 °C after the same mass has accumulated, the modelled pressure drop decreases to approximately 10.72 kPa, while the normalised index remains 2.53. A reduction in pressure drop caused by heating is therefore not misinterpreted as deposit removal.

This separation is valid only if α , R_m and cake structure remain unchanged. Temperature may affect these quantities in actual fuel, so the compensation requires experimental verification. If biofuel fraction is unknown, a calculated temperature correction alone is insufficient: composition information or an independent viscosity estimate is required.

Model validation should begin by determining R_m from clean element characteristics at several flow rates. Next, α and η should be estimated using measured μ , C and retained particle mass. Particle size distribution must be maintained or monitored because it affects retention and cake structure. Separate test series

should be reserved for validating the t_{cr} prediction rather than also being used to fit the coefficients.

Limitations. The model does not cover cake compression, particle detachment, depth pore blocking, biological contamination or crystallisation. Under variable flow rate, the mass balance takes an integral form and resistance must be coupled with the pump characteristic. Values of R^2 , statistical significance and experimental error are not reported because no independent measurement dataset is available.

Conclusions. Relationships for pressure drop, limiting cake mass, time to a specified limit and minimum filtration area are derived from the contaminant mass balance and a resistances-in-series model. They combine the effects of contamination and blended fuel properties under constant flow rate conditions.

In the baseline scenario at $Q = 100$ L/h, $A = 0.050$ m² and $T = 20$ °C, increasing contaminant concentration from 5 to 20 mg/L reduces the calculated time to 30 kPa from 39.47 to 9.87 h. At $C = 10$ mg/L, increasing biofuel fraction from 0 to 30% reduces this time by 31.8% under the assumed viscosity relationship.

For a required duration of 20 h, the calculated area is 0.0503 m² for B0 and 0.0595 m² for B30. The local sensitivity coefficients of time to flow rate and area are -2.20 and 2.20, respectively, supporting the need for accurate flow rate control and determination of effective area.

Within the model, the normalised index I_r separates additional resistance from the direct effects of viscosity and flow rate. Practical application requires coefficient identification and independent validation for a specific filter. The numerical results are scenario estimates rather than established operating requirements.

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МОДЕЛЮВАННЯ ВПЛИВУ ЗАБРУДНЕНOSTІ СУМІШЕВОГО ПАЛИВА НА ПАРАМЕТРИ ФІЛЬТРАЦІЇ В СИСТЕМІ ЖИВЛЕННЯ ДИЗЕЛЬНОГО ДВИГУНА

У статті розглянуто вплив механічних домішок, частки біопалива та температури сумішевого палива на гідравлічні параметри фільтрації в системі живлення дизельного



двигуна. Метою роботи є обґрунтування розрахункового підходу до визначення перепаду тиску та тривалості роботи фільтра до досягнення заданого граничного значення з урахуванням накопичення затриманих частинок. Методика поєднує баланс маси забруднень із моделлю послідовного додавання опорів чистого фільтрувального матеріалу й шару осаду за сталої об'ємної витрати палива.

Отримано аналітичні залежності для розрахунку перепаду тиску, граничної маси затриманих домішок, часу до досягнення встановленого перепаду та мінімальної ефективної площі фільтрації. Розрахунки виконано для об'ємної частки біопалива 0, 15 і 30 %, температури 20–40 °С та концентрації механічних домішок 5–20 мг/л. У базовому розрахунковому прикладі за витрати 100 л/год і площі фільтрації 0,050 м² збільшення концентрації домішок із 5 до 20 мг/л скорочує час до досягнення перепаду тиску 30 кПа з 39,47 до 9,87 год. За прийнятої залежності в'язкості від складу палива збільшення частки біопалива з 0 до 30 % за температури 20 °С зменшує цей час на 31,8 %. Для забезпечення розрахункової тривалості фільтрації 20 год за концентрації домішок 10 мг/л необхідна площа становить 0,0503 м² для В0 і 0,0595 м² для В30.

Запропоновано нормований показник додаткового опору, який у межах прийнятої

моделі дає змогу відокремити вплив накопичення забруднень від безпосереднього впливу в'язкості та витрати палива. Визначено локальні коефіцієнти чутливості розрахункового часу до основних параметрів. Для базових умов коефіцієнти чутливості до витрати та площі фільтрації становлять відповідно –2,20 і 2,20, що підтверджує необхідність точного врахування цих величин під час оцінювання стану фільтра.

Числові результати отримано аналітичним розрахунком за заданих параметрів; експериментальна перевірка конкретного фільтра в межах роботи не проводилася. Практичне значення запропонованих залежностей полягає в можливості їх використання для планування випробувань, попереднього вибору площі фільтрації та обґрунтування параметрів системи моніторингу стану паливного фільтра. Застосування моделі до конкретної системи живлення потребує визначення її коефіцієнтів за вимірюваннями та перевірки прогнозованого часу до граничного перепаду тиску.

Ключові слова: паливна система, система живлення, нафтопродукти, біопаливо, біодизель, моніторинг якості палива, системи контролю якості.

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