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INFLUENCE OF DIFFERENT TYPES OF WATER PURIFICATION ON THE SDS-SEDIMENTATION EXPONENT

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Abstract

The results of a comparative evaluation of the influence of the water purification efficiency on an amount of sediment during SDS-sedimentation of samples of soft winter wheat are submitted.

The influence of 5 types of water purification on the sedimentation exponent were studied: 1 – distilled water, 2 – deionized water, 3 – deionized boiled water, 4 – tap water, 5 – tap boiled water.

It was established that high purified deionized boiled water resulted in the highest sediment level ($\overline{\delta}_{di.b}$ = 58 ml) at SDS-sedimentation.

Deionized water without boiling resulted in a lower sediment level than when using distilled water (at an average of $\Delta\overline{\delta}_{di}$ = 4 ml).

Usage of tap water (including water after boiling) substantially reduced the amount of sediment at SDS-sedimentation.

Keywords: soft winter wheat, distilled water, deionized water, sediment level, SDS-sedimentation.

INTRODUCTION

Grain quality is a compound pheno- and genotypical dependent feature. The most important indicator of wheat quality, among many others, is bread-making characteristic of flour. The highly sensitive device – alveograph – is used for detailed assessments of the bread-making characteristic of big samples; the main indicator of the device is flour strength (W,e.a.). But it's impossible to use this device in the early phases of selection and for the prompt assessments because of the shortage of grain and time. In this case, indirect express methods of research help the scientists and manufacturers [1, 2]. (Kopus' et al., 2010; Samofalova et al., 2014).

The sedimentation index is an indirect method of flour strength determination which lies in measuring the swollen flour particles sediment volume in a lean solution of organic acids that couldn't accumulate during 10-15 min. This method was suggested by Zeleny (1962) [3] and was modified multiply as in our country as in abroad (Ayoub et al., 1993; Moonen et al., 1982; Axford et al., 1979; Morris et al., 2007) [4, 5, 6, 7]. It is included in the standards of wheat grain quality by the leading world's grain manufacturers and exporters (such as USA, Canada, Australia and European countries). It is used in selection programs of Russia. During last six years, SDS-sedimentation is used in VNIIZK named after I. G. Kalinenko at the selection, seed farming and technology of winter durum wheat and soft wheat. For the years, the methodology of this indicator determination has been well-tested. But with the lapse of time, the new work conditions appear, and they require implementation of additional researches.

One of the promising variants of SDS-sedimentation is using of water cleaned in a new way. This new method is realized in the special apparatus "Aqualab" UVOI M-F 1812-2 model 3, which is produced by the firm "Scientific-productive company", a limited corporation "Mediana-Filter" (SPC Ltd., "Media-Filter") [Moscow, Russia]. The production of cleaned (deionized) water differs from the process of distillation, after which water is usually used for analyses. Since SDS sedimentation method has been adopted for the production of required water, we have used and are using electrical aqua distiller DE 10 "SPb", produced at the plant "Electromedequipmeent"

(St. Petersburg, Russia) [8] where clarified water is produced using separated steam condensation. That is, water, be subjected boiling, evaporation and condensation during the distillation process, gets rid of salts and air dissolved in it. Water doesn't run through the boiling and evaporation processes in the apparatus "Aqualab". The purification process occurs due to multilevel filtration, deionization, and disinfection of water in concordance with schematic diagram presented at Fig. 1 [9], but no special methods of water deaeration are used in this apparatus. You can judge about a level of air content in deionized water produced in "Aqualab" by indirect sign, specifically by seeing a lot of air bubbles in the water which is in the container for its storage while you can't see air bubbles in the container for distilled water storage.

The aim of our investigations is to appreciate the influence of different ways of water purification (including these two apparatus) at SDS-sedimentation characteristics of winter soft wheat selection samples and to study the possibility to use any of these investigated types of water, including deionized water, during analytical assessments and quality control work instead of distilled water.

MATERIALS AND METHODS

The current analytical material of soft winter wheat has been used for the grain quality analysis – 20 samples of the 2014 harvest collection grown in the VNIIZK named after I. G. Kalinenko.

The comparative assessment of SDS-sedimentation characteristics was held by methodology stated in the VNIIZK scientific-practical guidelines (Samofalova et al., 2014) [2], except the differences in water used for to carry out the analysis. Five kinds of water purification have been used for experiments: 1) distilled water produced at the aqua distiller DE-10 (by methodology); 2) deionized water purified at the "Aqualab"; 3) deionized water after boiling; 4) tap water; 5) tap water after boiling. Tap water was poured into the glass and kept till indoor temperature level. Other water samples (as deionized as tap water) were boiled at the electric cooker in a cone flask with an open neck during 15 minutes, and then they were left till temperature equalizing to indoor temperature.

Mathematical treatment of the investigations results was held according to Dospehov (1985) [10].

RESULTS AND DISCUSSION

The comparative assessment results of different types water purification influence at sediment level at SDS-sedimentation are shown in Tables 1 and 2 and Fig. 2.

From submitted data in the Table 1 and Fig. 2 it is clear that deionized water (after boiling, the 3rd kind of purification) produced at the apparatus "Aqualab" has the highest level of SD-sedimentation, $\Delta\delta_{di.b}$ = +3 ml, in comparison with distilled water ($\Delta\delta_{di.b}$ = 58 ml and $\Delta\delta_{d}$ = 55 ml respectively). The difference of some samples № 3705, 3706, 3708 was higher: +7, +8 ml. And the sediment level was lower than in distilled water only in two samples (№ 3700 и № 3715): -3, -2 ml, that was permitted.

The opposite sign is seen in the tap water with boiling and without it (Table 2, Fig. 2) and in the deionized water without boiling after "Aqualab" (Table 1 and Fig. 2). The sedimentation level is lower than in the distilled water at the amount $\Delta\delta_{di.b}$ = – 4 ml, $\Delta\delta_{tw}$ = – 6 ml, $\Delta\delta_{tw.b}$ = – 4 ml (№ 3700 и № 3715). Thereby, only deionized water from apparatus "Aqualab" after boiling (which provides air removing) gives the highest level of sediments, in this connection it may be recommended for using at SDS-sedimentation instead of distilled water. When deionized water after "Aqualab" without boiling is used for tests the level of sediments is lower than the level at distillate (at an average $\Delta\delta_{di}$ = – 4 ml), so this type of water is not recommended for practical use. Tap water shouldn't be used for tests (variant 4), including water after boiling that reduces water hardness and provides air removing (variant 5) so as some sediments is still rather lower than at distilled water ($\Delta\delta_{tw.b}$ = – 4 ml).

CONCLUSIONS

The presented data indicate that water purification quality influences very much on the amount of sediment in samples of soft winter wheat at SDS-sedimentation.

High-level purified deionized water produced by the apparatus "Aqualab", and only after boiling that provides air removing from it, gives the highest level of sediment during the experiments ($\Delta\delta_{di.b}$ = 58 ml).

Distilled water produced at the unit DE-10 is at the second place according to some sediments ($\Delta\delta_{d}$ = 55 ml).

Tap water influences negatively on some sediments at SDS-sedimentation in comparison with distilled water either with or without boiling.

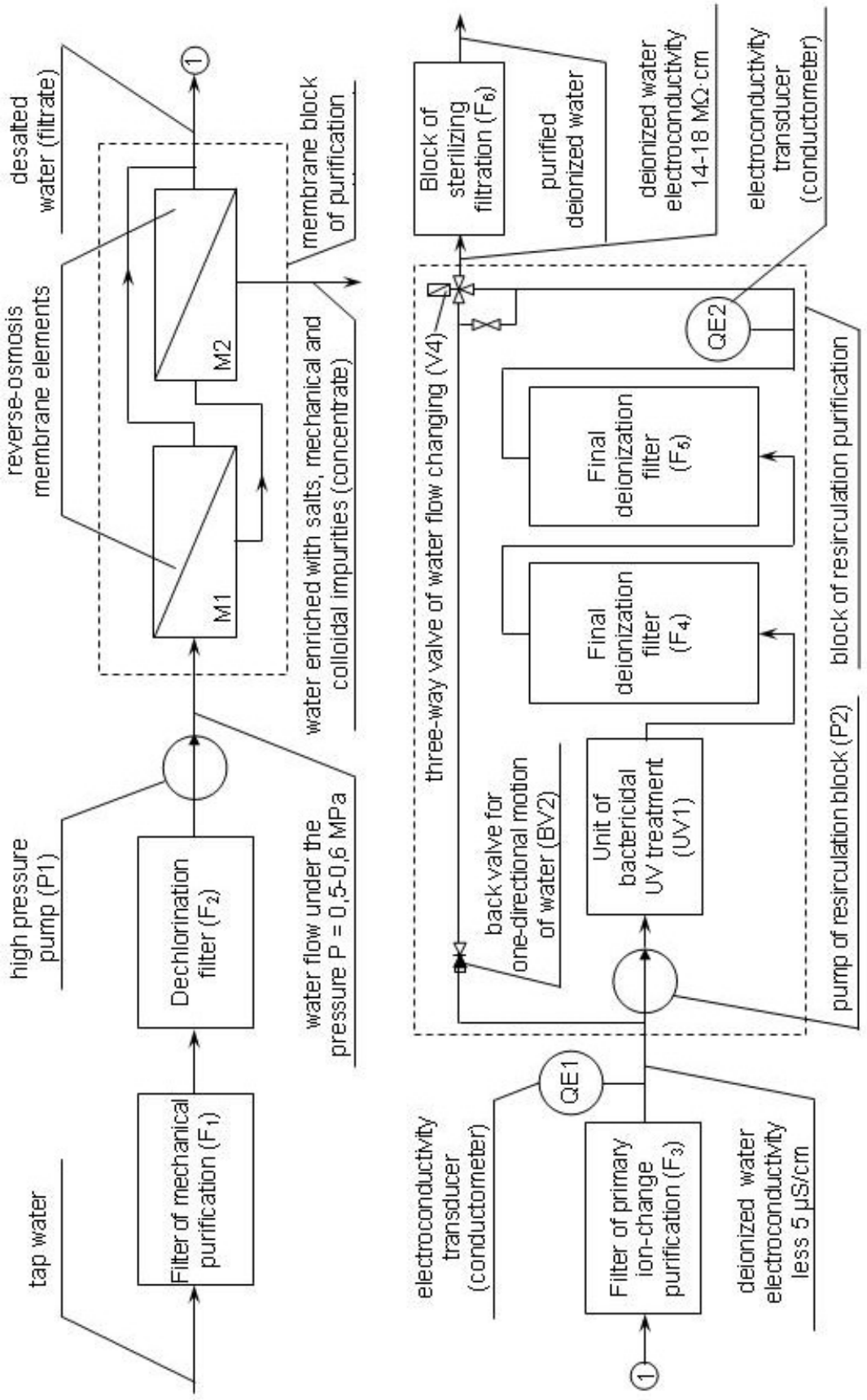

***Fig. 1.** Production of purified deionized water in the unit «Aqualab» UVOI-M- F 1812-2 model 3 graphic pattern*

RECOMMENDATIONS

So, by finding the use of deionized water after boiling is recommended instead of distilled water as during carrying out SDS-sedimentation tests, as for using during any biochemical and molecular- genetic analyses, at electrophoresis of proteins in the starch gel, etc.

Besides wide practical usage of deionized water after boiling instead of distilled water during carrying out laboratory analyses makes it possible considerably to reduce tap water consumption (in 25 times) that is the source for both these types of purified water costs for production of 1 dm^3 (l) of distilled water are 25 times more than costs for 1 dm^3 deionized water [8, 9].

Table 1. Influence of water purification efficiency on amount of sediment during SDS-sedimentation at samples of soft winter wheat (distilled and deionized water)

Test sample	Sediment level at distilled water usage, δ_d, ml	Sediment level at distilled water usage, ml				Deviation between the versions of deionized water usage, $\Delta\delta = (\delta_{di.b} - \delta_{di})$, ml
		Without boiling		With boiling		
		Sediment level, δ_{di}, ml	Deviation, $(\delta_{di} - \delta_d)$, ml	Sediment level, $\delta_{di.b}$, ml	Deviation, $(\delta_{di.b} - \delta_d)$, ml	
1	2	3	4	5	6	7
3697	58	50	– 8	59	+ 1	+ 9
3698	56	50	– 6	57	+ 1	+ 7
3699	60	52	– 8	64	+ 4	+ 12
3700	60	52	– 8	57	– 3	+ 5
3701	57	53	– 4	57	0	+ 4
3702	53	51	– 2	58	+ 5	+ 8
3703	53	53	0	56	+ 3	+ 3
3704	56	53	– 3	59	+ 3	+ 6
3705	51	50	– 1	59	+ 8	+ 9
3706	50	49	– 1	57	+ 7	+ 8
3707	52	45	– 7	53	+ 1	+ 8
3708	47	47	0	55	+ 8	+ 8
3709	56	50	– 6	58	+ 2	+ 8
3710	59	48	– 11	60	+ 1	+ 12
3711	56	54	– 2	60	+ 4	+ 6
3712	50	47	– 3	56	+ 6	+ 9
3713	52	48	– 4	56	+ 4	+ 8
3714	56	56	0	61	+ 5	+ 5
3715	62	57	– 5	60	– 2	+ 3
3716	60	55	– 5	60	0	+ 5
Average, $\overline{\delta}_{d,di\,i}$	55	51	–	58	–	–
Deviation $\Delta\overline{\delta}_{di\,i} = (\overline{\delta}_{di\,i} - \overline{\delta}_d)$	0	– 4	–	+ 3	–	–
LAD $_{05}$	–	2,7	–	2,8	–	–

Table 2. Influence of water purification efficiency on amount of sediment during SDS-sedimentation at samples of soft winter wheat (distilled and tap water)

Test sample	Sediment level at distilled water usage, δ_d, ml	Sediment level at tap water usage, ml				Deviation between the variants of tap water usage $\Delta\delta = (\delta_{tw.b} - \delta_{tw})$, ml
		Without boiling		With boiling		
		Sediment level, δ_{tw}, ml	Deviation $(\delta_{tw} - \delta_d)$, ml	Sediment level, $\delta_{tw.b}$, ml	Deviation $(\delta_{tw.b} - \delta_d)$, ml	
4	2	3	4	5	6	7
3697	58	51	– 7	53	– 5	+ 2
3698	56	50	– 6	52	– 4	+ 2
3699	60	54	– 6	54	– 6	0
3700	60	53	– 7	57	– 3	+ 4
3701	57	52	– 5	56	– 1	+ 4
3702	53	48	– 5	50	– 3	+ 2
3703	53	47	– 6	50	– 3	+ 3
3704	56	50	– 6	51	– 5	+ 3
3705	51	45	– 6	48	– 3	+ 3
3706	50	45	– 7	49	– 1	+ 4
3707	52	43	– 9	47	– 5	+ 4
3708	47	41	– 6	45	– 2	+ 4
3709	56	49	– 7	50	– 6	+ 1
3710	59	50	– 9	52	– 7	+ 2
3711	56	50	– 6	53	– 3	+ 3
3712	50	48	– 2	50	0	+ 2
3713	52	49	– 3	51	– 1	+ 2
3714	56	48	– 8	52	– 4	+ 4
3715	62	50	– 12	55	– 7	+ 5
3716	60	50	– 10	53	– 7	+ 3
Average $\bar{\delta}_{d,tw\,i}$	55	49	–	51	–	–
Deviation $\Delta\bar{\delta}_{tw\,i} = (\bar{\delta}_{tw\,i} - \bar{\delta}_d)$	0	– 6	–	– 4	–	–
LAD $_{05}$	–	3,0	–	2,5	–	–

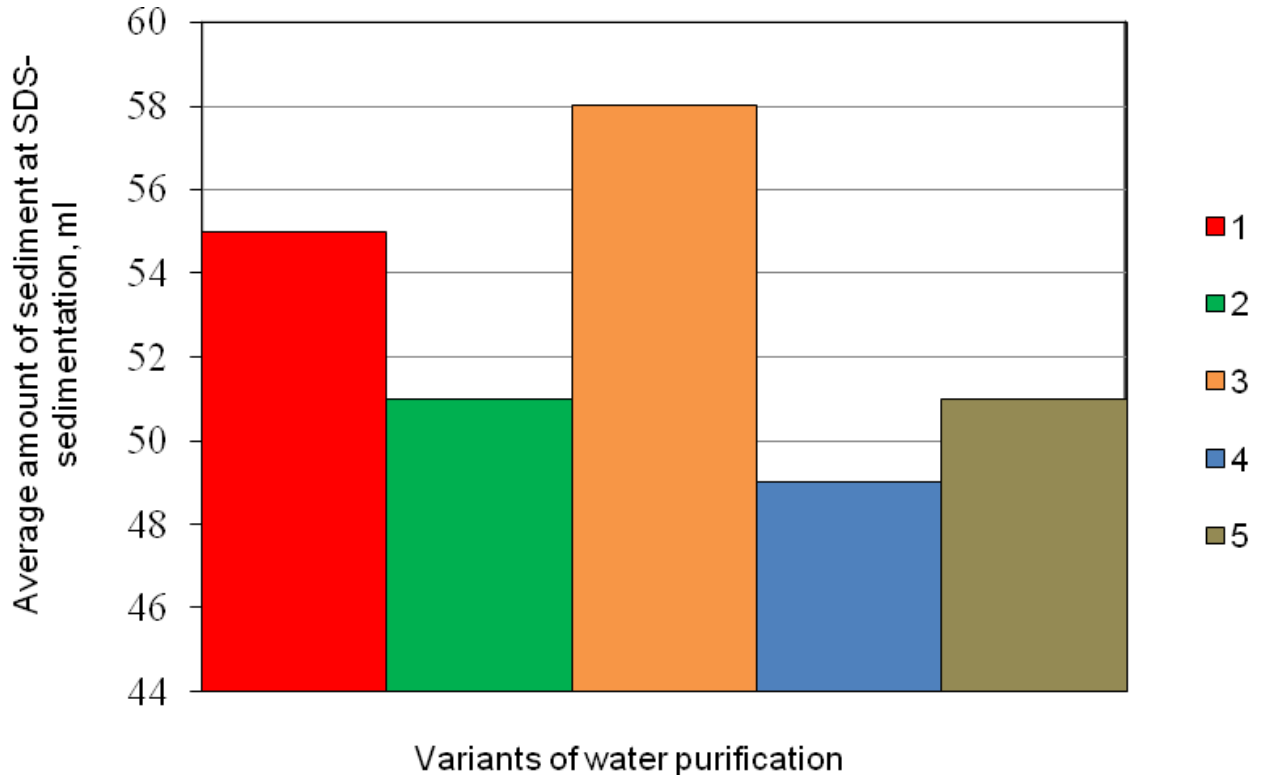

Fig. 2. *The average amount of sediment at SDS-sedimentation for different variants of water purification: 1 – distilled water, 2 – deionized water, 3 – deionized water after boiling, 4 – tap water without boiling, 5 – tap water after boiling*

REFERENCES

Kopus', M.M., V.P. Necvetaev, E.M. Kopus', A.R. Makarova, O.V. Necvetaeva, 2010. Express methods of wheat selective material assessment according to the grain quality – Science and Technology Progress in AIC, № 1: 19-21 [1].

Samofalova, N.E., M.M. Kopus', O.V. Skripka, D.M. Marchenko, A.P. Samofalov, N.P. Ilichkina, T.A. Grichanikova, 2014. SDS-sedimentation in winter wheat selective material step-by-step assessment according to the grain quality (methodological guidance). ZAO "Kniga", Rostov-on-Don. 32 p. [2].

Zeleny, L., 1962. Wheat sedimentation test. Cereal science today, Vol. 7, № 7. p. 226-230 [3].

Ayoub, M., J. Fregeau-Reid, D.L. Smith, 1993. Evaluation of the SDS-sedimentation test for the assessment of eastern Canadian bread wheat quality – Canadian Journal of Plant Science, 73(4): 995-999 [4].

Moonen, J.H.E., A. Scheepstra, A. Graveland, 1982. Use of the SDS-sedimentation test and SDS-polyacrylamide gel electrophoresis for screening breeder's samples of wheat for bread-making quality – Euphytica, 31 (3): 677-690. (doi:10.1007/BF00039206) [5].

Axford, D.W.E., E.E. McDermott, D.G. Redman, 1979. *Note on the Sodium Dodecyl Sulfate Test of* Bread making Quality: Comparison with Pelshenke and Zeleny Tests – Cereal Chemistry, 56(6): 582-584 [6].

Morris, C.F., B. Paszczynska, A.D. Bettge, G.E. King, 2007. A critical examination of the sodium dodecyl sulfate (SDS) sedimentation test for wheat meals – Journal of the Science of Food and Agriculture, 87 (4): 607–615 [7].

1993. Aquadistiller electrical DE-10 "SPb". Maintenance manual. "Electromed-equipment" works, St.-Petersburg. 31 p. [8].

2013. Unit "Aqualab" UVOI-M-F 1812 model 3 (for producing of highly purified water). NPK ZAO "Mediana-Filter" Moscow. 175 p. [9].

Dospehov, B.A., 1985. Methodology of field experiment (with statistical treatment foundation of the research results). Agropromizdat, Moscow. 351 p. [10].