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TOPOLOGICAL ANALYSIS OF TIME SERIES IN THE PROCESS OF SEARCHING PRECEDENTS FOR THE FILLING OF THE BASE OF PRECEDENTS OF THE DECISION SUPPORT SYSTEM OF THE PRECEDENT TYPE

Annotation. The topological analysis of time series of technological variables of the process of the saturation on the sugar plant is discussed in this article. The topological analysis is using for searching precedents for filling the base of precedents for the decision support system.

Keywords: precedent, topological analysis.

The decision support system needs to have the experience, which is saving as precedents in the base of precedents, for the optimal managing of the technological objects. The searching of precedents and saving them in the base of precedents is conducting in time series of technological variables, which were got from the

process of managing of technological objects of the sugar plant in the past.

The analysis of time series of technological variables was conducted on the next method.

The time series of values of the juice pH after the second saturation process was chosen for analysis, which is shown on the fig. 1.

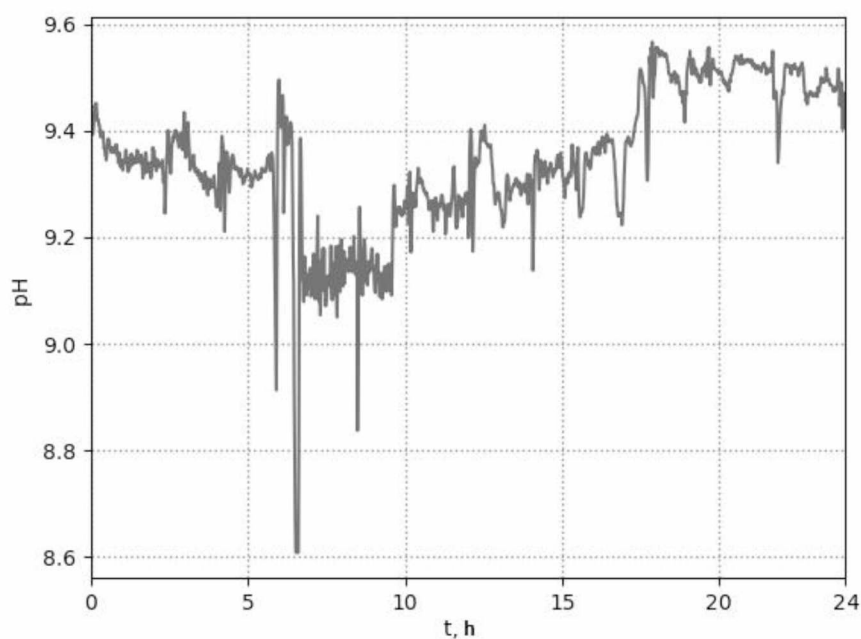


Figure 1. Time series of values of the juice pH after the second saturation process.

The change of values of the juice pH during the day is shown on the fig. 1. This time series was divided into hours for the ease of the analysis and the similar cases of changes of time series were selected. The

changes of values of the juice pH after the second saturation process during the 17th and the 23rd hour are shown on the fig. 2a and 2b.

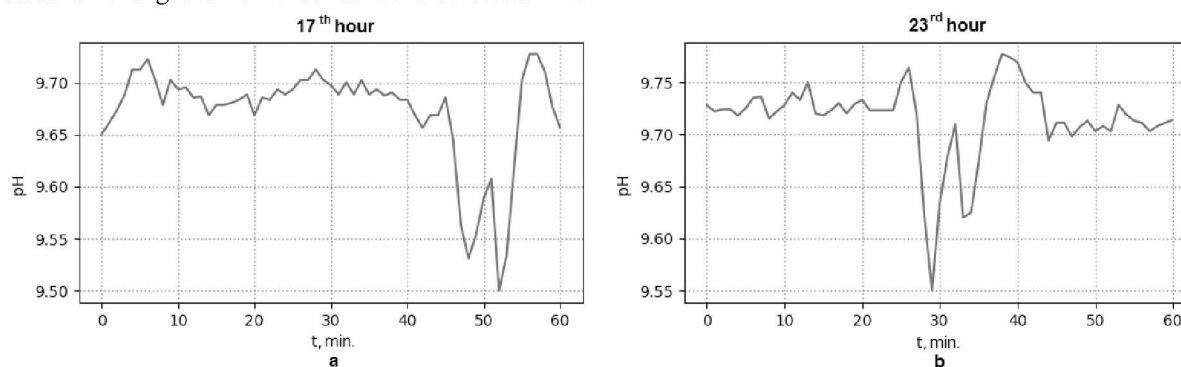


Figure 2. Change of values of the juice pH during the 17th and the 23rd hour

One of the causes of the change of values of the juice pH after the second saturation process can be the juice temperature before the second saturation process.

The change of values of the juice temperature before the second saturation process during the 17th and the 23rd hour are shown on the fig. 3a and 3b.

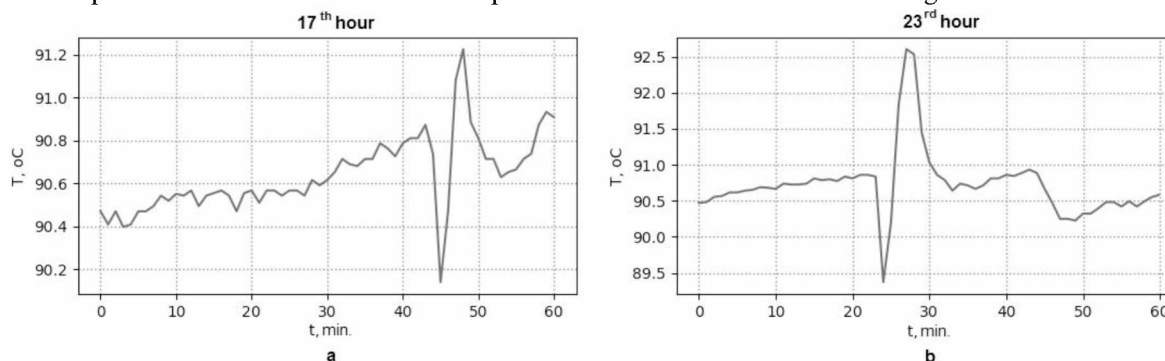


Figure 3. Change of values of the juice temperature during the 17th and the 23rd hour.

The carried out topological analysis of the time series [1, 15] shows that topological figures with codes TU=1234567 (fig. 4a) and TU=7654321 (fig. 4b) meet in time series very often.

These topological figures were used for the topological analysis of time series of temperature and pH juice. These topological figures were decomposed on the topological figures of the low level for the more detail topological analysis of time series.

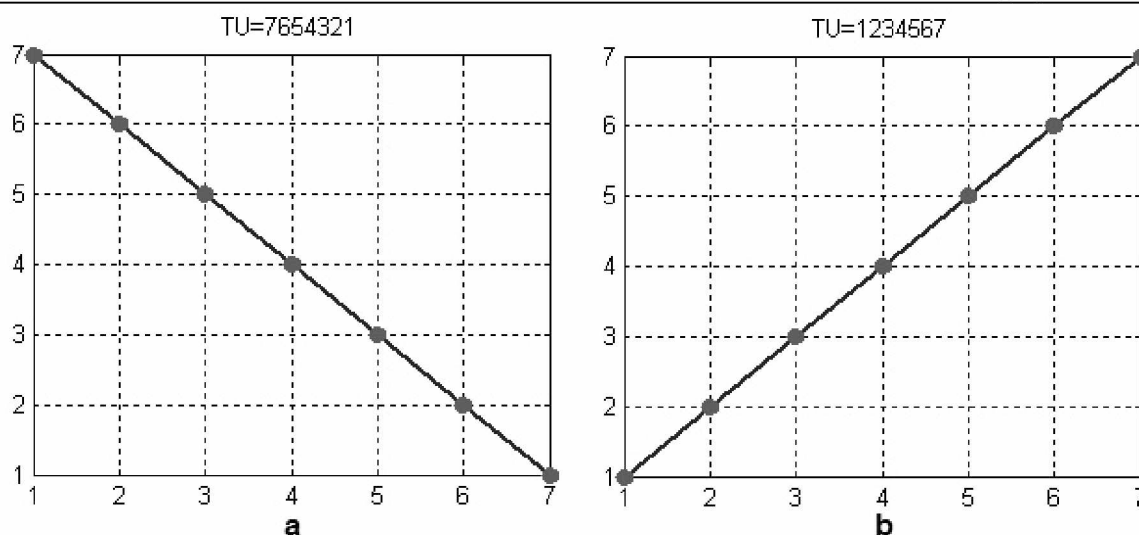


Figure 4. Topological figures with codes $TU=1234567$ and $TU=7654321$.

The process of the decomposing topological figures was conducted on the next method [2, 285] and the results, which were got, are shown on the fig. 5a and 5b:

$$T_{71}^2 \leftarrow T_{74}^1 * T_{41}^1 \quad (1)$$

$$T_{17}^2 \leftarrow T_{14}^1 * T_{47}^1 \quad (2)$$

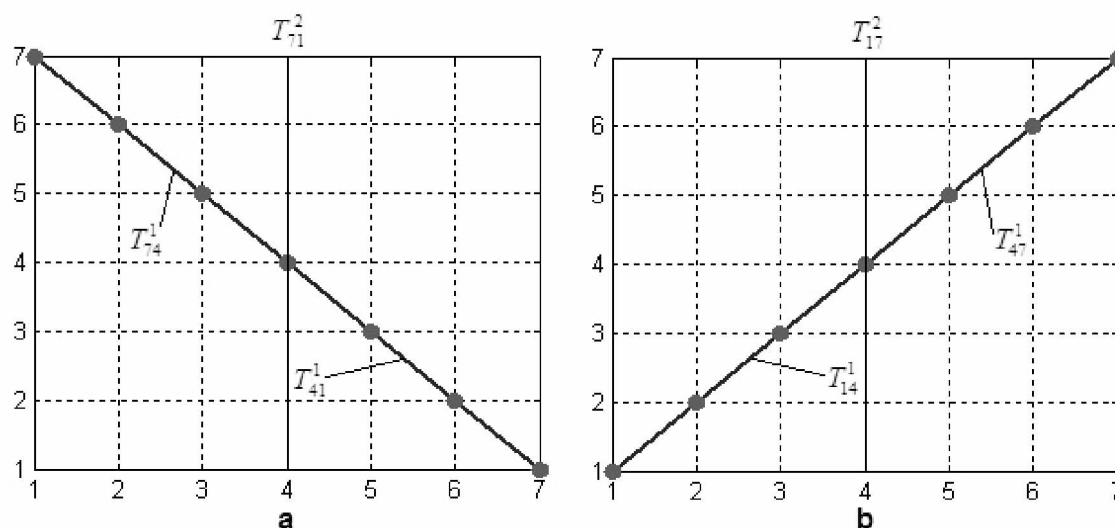


Figure 5. Results of the decomposing topological figures

The description of time series of temperature and pH juice with using these topological figures are shown on the fig. 6a and 6b.

Next graphs, which were shown on the fig. 7a and 7b, were built for detecting the trend of time series and choosing the precedents in the time series. The marks, which were shown on the graphs: dT and dpH – the distance between the first and the last point of topological figures; n – the number of topological figures. The precedents were marked with help the rectangles on the fig. 7.

The detected precedents are being described topological figures of the high level then these topological figures are being saved in the base of precedents of the decision support system of the precedent type.

The filling of the base of precedents of the decision support system with precedents, which are describe the change of temperature juice, will be able to manage the change of pH juice during the technological process of the second saturation in the future more optimally.

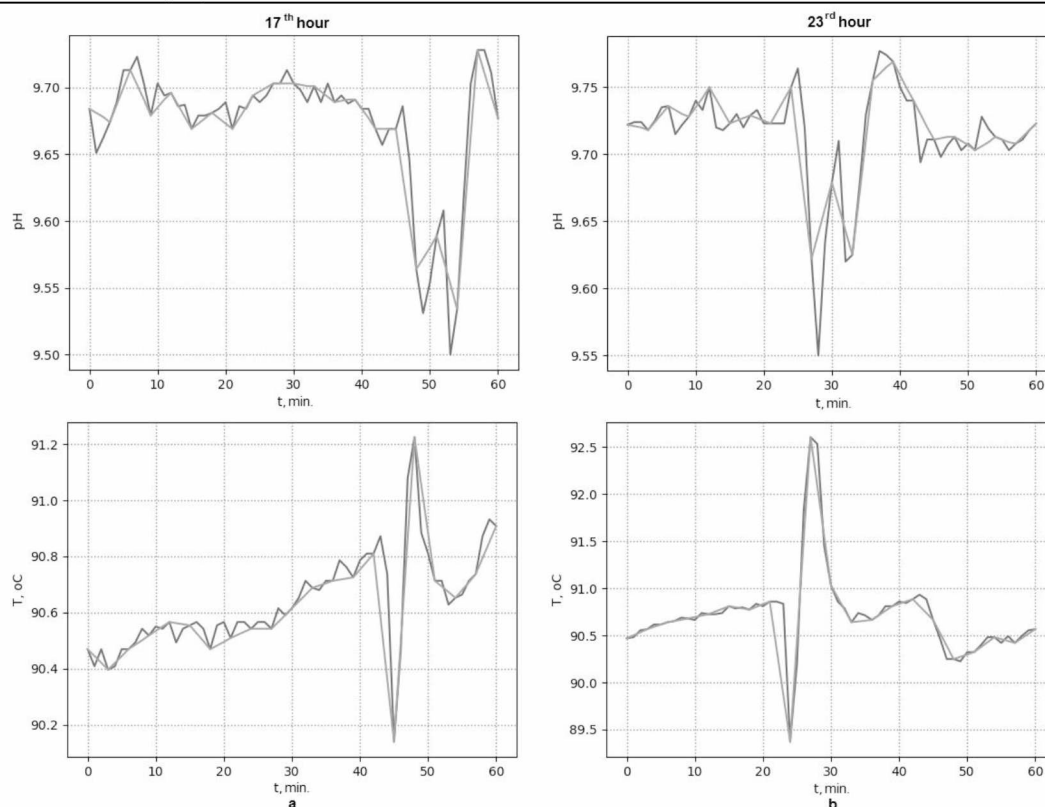


Figure 6. Description of time series with using these topological figures.

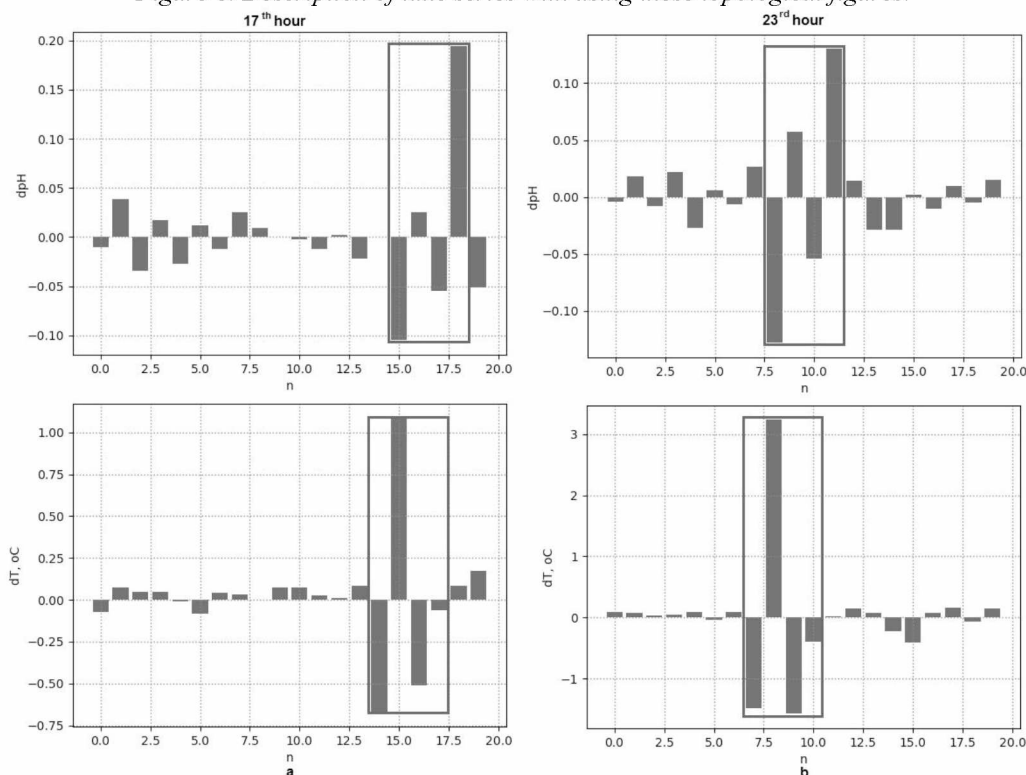


Figure 7. Detecting precedents in the time series.

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