

Legal aspects of protection of mineral waters in Slovakia

GABRIELA VANDROVÁ¹ and MARIÁN FENDEK²

¹INGEO, joint stock company, Bytčická 16, 010 01 Žilina

²Geological Survey of Slovak Republic, Mlynská dolina 1, 817 04 Bratislava

Abstract: Natural mineral waters are from economic, cultural and therapeutic point of view a very important element of a country's natural wealth. Their usage is very versatile. They are sources of precious water-soluble elements and are one of the substances with a specific importance for people and their health. Besides being used for healing and recreational purposes in spas, mineral waters are also used as refreshing beverages. Because of their versatile usage, it is essential to protect them. Protection of mineral waters in Slovakia is based on legislation presented in this paper. The authors describe the basic principles applied for the protection of mineral waters resulting from this legislation, and the ways and the extent to which it is provided for with the existing or prospective sources of mineral waters in Slovakia.

Introduction

In compliance with the regulations of the European Water Chart and with social necessity, it is essential to protect, regulate and regenerate surface and ground waters with a responsibility corresponding to the extent of their exploitation. According to the Slovak Constitution, surface and ground waters are part of the national heritage. The active protection of waters, both qualitative and quantitative, results directly from the Act No. 138/73 Coll., on Waters (water law), as amended (Slovak Parliamentary Act No. 238/1993, Coll., Slovak Parliamentary Act No. 199/1995, Coll.).

The water law applies to waters designed as "special waters", only if so specified. Such waters are natural healing waters and naturally occurring mineral-rich potable waters, to which applies the Slovak Parliamentary Act No. 277/1994, Coll. on Healthcare and the Amendment to the Slovak Parliamentary Act No. 277/1994 from August 1, 1998, Part 9). According to the Slovak Technical Norm 86 8000 (August 26, 1965), mineral waters are divided into:

1. *Natural mineral waters:* they flow from natural springs or from water catching devices, which, in the site of the efflux include more than 1 g of soluble substances, 1 g of dissolved carbon dioxide, 1 mg of titratable sulphur, 5 mg I, 10 mg of Fe²⁺, 0.7 mg of As in 1 litre of water and have an elevated content of F, Cu, Zn, Co, Mo, Li, Sr, Ba, of the boric or silicic acids, or of organic substances and whose radioactivity reaches 100 Mach's units (37 $\mu\text{Ci.l}^{-1}$).

2. *Natural healing waters:* due to their chemical composition and their physical properties, according to scientific evidence, these waters include health-beneficial substances, that it is in the public interest to use these waters for healing purposes.

3. *Natural mineral-richpotable waters,* due to their chemical composition, physical and sensual properties, these waters can be used as refreshing beverages. 1 litre

of natural mineral-richpotable waters includes at least 1 g of dissolved carbon dioxide and a maximum of 6 g of dissolved solids, which do not have substantial pharmaceutical effect, either individually or as a group.

Natural mineral waters are very important from economic, cultural and therapeutic assets. Their utilisation is very versatile. They are sources of precious water-soluble elements and are one of the substances with specific importance for people and their health. Besides being used for healing and recreational purposes in spas, mineral waters are also used as refreshing beverages. The versatile usage of mineral waters made it necessary to protect them as early as in the distant past.

Mineral waters have specific qualities, resulting from their physical, chemical and biological properties, from the geologic conditions in which they were formed, from the accumulation and flowing through a particular geological environment. These properties and conditions are highly variable - they vary according to time, space and depth of the circulation (Melioris et al., 1986). Therefore, it is not possible to unify the methods of research and exploration of those hydrogeological structures, which include mineral waters in order to protect them. Instead, it is necessary to adjust these methods to the given natural conditions.

Protection of mineral waters

Outline of Legislation Providing for Protection of Mineral Waters

The first regulations concerning the protection of mineral waters in Slovakia were worked out during the second half of the 19th century for the spas of Piešťany, Trenčianske Teplice, Dudince, Bojnice and Sliač. These regulations were based on the old Hungarian Health and Water Law of 1876, Section No. 1 XIV - healing spas and mineral waters and on the 1885 Act No. 1 XXIII as well as the Circular Decree No. 44404 of 1893. The 1885 Act

delimited protection zones, a guarantee to their owners, according to which nobody was allowed to drill or dig in the zones without a special permit (Krahulec, 1972). These laws were amended in 1920 and were in force until 1955, when new laws and legislative norms were issued. This include:

- *Act on Czechoslovak Spas and Mineral Springs No. 43 from 1955,*
- *Health Ministry's Regulation on Protection of Natural Therapeutic Spas and Natural Healing Sources and on their usage No. 151 from 1956,*
- *Act on Providing for People's Health No. 20 from 1966,*
- *Czechoslovak State Norm (ČSN) 86 8000 "Natural Healing Waters and Natural Mineral-rich potable Waters", from 1965,*
- *Decree of the Health Ministry of the Slovak Socialist Republic No. 15, from 1972 on Protecting and Developing Natural Therapeutic Spas and Natural Healing Sources,* which sets the conditions for establishing natural therapeutic spas, identifying natural sources of mineral waters, gasses, emanations, peats, swamps, muds and other healing soils, promulgating the sources of natural mineral-richpotable waters, declaring ambience conditions favourable for healing and deciding on their utilisation. An important part is the protection of the natural therapeutic spas, natural healing sources and sources of mineral-richpotable waters.
- *Directive of Slovak Geological Office and the Health Ministry of the Slovak Socialist Republic (SSR) No. 55/1977 on acquiring of data for delimiting protection zones of natural healing sources and natural sources of mineral-richpotable waters,*
- *Regulation of the SSR's Health Ministry No. 77/1982, Coll., which is an amendment to the Regulation No. 15/1972 Coll., that specifies the collecting records of thermal and mineral waters, gasses and emanations, etc.,*
- *Section Norm (ON) 86 8001 Natural Healing Waters and Natural Mineral-richPotable Waters from 1984 - characteristics of individual springs,*
- *Methodical instructions of the Slovak Geological Office and the SSR's Health Ministry from 1989 on delimiting protection zones of natural healing water sources and natural sources of mineral-rich potable waters,* which aims at providing a rational, methodologically correct and unified project making, performing and assessing of the geological studies necessary for obtaining data through which to delimit protection zones around natural healing water sources, natural sources of mineral-richpotable waters and of mineral waters,
- *Slovak Parliamentary Act No. 52/1988, Coll. on Geological Works and on Slovak Geological Office (geological law), in the wording of the Slovak Parliamentary Act No. 479/1991, Coll. and some of the related regulations, above all Regulation of the Slovak Ministry of the Environment No. 217/1993, Coll., on Designing, Performing and Assessing of Geological Studies,* which defines the geological works and the conditions of their accomplishing,

- *Slovak Parliamentary Act No. 44/1988, Coll., on Protecting and Exploiting Mineral Wealth (mining law) in the wording of the Slovak Parliamentary Act No. 498/1991, Coll., and some related regulations;* it is a complex of legal norms, which regulate and define mining and mining related activities, exploiting and protecting deposits of minerals. It also addressed their administration and delimits some further conditions for accomplishing the aforementioned activities

- *Slovak Parliamentary Act No. 277/1994, Coll., on Healthcare,* which also applies to the protection of natural therapeutic spas, natural healing sources and natural sources of mineral-rich potable waters and mineral waters,

- *Decree of the Slovak Health Ministry No.116/1996, Coll. on parameters necessary for declaring ambience conditions that are favourable for healing and on ways of the listing these amenities,*

- *Slovak Parliamentary Act No. 241/1998 dealing with natural healing sources and natural sources of mineral-richpotable waters,* which are the property of the State.

The aforementioned legal norms are inseparable from laws on the State Administration in the individual fields, as well as for individual executive decrees and regulations delimiting the expert abilities necessary for to undertake specified activities. All dealings connected to the regulation of individual activities by the State Administration bodies have been registered in compliance with the provisions of the *Slovak Parliamentary Act No. 71/1967, Coll., on Administration Proceedings.*

These legislative measures were substituted for the previous outdated provisions and norms. They acknowledge the great importance of our natural therapeutic spas, which provide for maintenance of health as well as for the treatment of ailments of people. The legislative norms provide for their protection and for a planned establishment of conditions for their further development.

Process of Declaring a Natural Source a Natural Healing Source or Source of Mineral-rich Potable Water

The criteria of dividing natural healing sources of mineral water from other waters are listed in detail by the *Decree of the Slovak Health Ministry No. 151/1956* on protecting natural therapeutic spas and natural healing sources and their usage. A detailed implementation of the decree is included in the Czechoslovak State Norm (ČSN) 86 8000 (currently the Slovak Technical Norm - STN 86 8000) "Natural Healing Waters and Natural Potable Waters". Currently, a proposal for a new norm on natural healing waters and natural sources of mineral-rich potable waters is being prepared.

The process of declaring a natural source as a natural healing source or a source of mineral-rich potable water is set by the Act No.241/1998, according to which natural sources of waters, peats, swamps, muds, gasses and emanations can be declared natural healing sources if:

- it has been scientifically proven that they are beneficial for human health due to their chemical composition and for physical properties,

- it is possible to use them for healing purposes in their natural state or after such an adjustment which does not damage their healing properties,

- their application is beneficial for man,
- they are hygienically harmless.

Natural source of mineral waters can be declared a source of mineral-rich potable water if:

- regarding their chemical composition, physical and sensual properties, they can be used as refreshing beverages and are beneficial for man,
- they are hygienically harmless,
- they can be bottled in their natural state or after an adequate adjustment.

A proposal for declaring a natural healing source or a source of mineral-rich potable water shall be submitted to the Slovak Health Ministry by a legal or physical entity which wants to use the natural source of mineral water for treatment in a spa or for bottling. The proposal has to include:

- a) particulars of the legal or physical entity (business name, address of the premises, legal form etc.),
- b) expert description of the source and its surroundings,
- c) assessment of the required hydrogeological investigation,
- d) assessment of the required hydrodynamic test (made within two years of the document submittal date),
- e) physical, chemical, micro-biological and biological analysis (they cannot be older than 6 months from the date declared the date of executing the analysis),
- f) proposal for utilization of the source,
- g) proposal for protection of the source,
- h) expert opinion on healing properties or other beneficial effects for man and its sphere of its utilization (offered within 6 months of the submittal date),
- i) data from the land register about the possession of a real property at which the healing water source is located, or which could be affected by utilization of the source (offered within 6 months of the submittal date).

A proposal for declaring a natural source of water a source of mineral-rich potable water has to include:

- a) the data presented in sections a) to g) and i),
- b) expert opinion on acceptability of the source from the point of view of its pharmaceutical effects on the man (given within 6 months of the declared date of elaboration).

A natural source is indicated the natural healing source or the source of mineral-rich potable water along with the protection zone of this source by a generally binding regulation issued by the Slovak Health Ministry (the same applies to cancelling the declaration if the source lost the prescribed properties and effects).

The Act No. 241/1998 delimits:

- under which conditions is it possible to obtain a permit for using a natural healing source or a source of mineral-rich potable water. The permit is issued for a maximum of ten years
- duties of the user of a natural healing source or a source of mineral-rich potable water,

- the conditions under which the permit for using a natural healing source or source of mineral-rich potable water expires or can be cancelled

The usage of a natural healing source and a source of mineral-rich potable water is decided on by the Slovak Health Ministry, which also decides on the user and administrator of these sources, their duties, conditions and extent of the usage, conditions for monitoring and their duties to the Slovak Health Ministry.

A natural healing source and a source of mineral-rich potable water and their products can be adjusted only after prior approval of the Slovak Health Ministry. Only natural water sources declared to be natural healing sources can be used for medical treatment in a spa. Only those water sources, that were declared to be sources of mineral-rich potable water or natural healing sources can be filled into bottles or other containers.

If the user changes, the new person interested in using the source shall ask the Slovak Health Ministry for a new users permit. Physical or legal entities interested in using natural healing sources or sources of mineral-rich potable water, shall ask the Slovak Health Ministry for a binding permit for their obtaining and using.

Providing for the Protection of Mineral Waters

Protection of mineral waters used in natural therapeutic spas is provided for by statutes on spas, protection zones, or by other protective measures. The statutes, issued on individual regional councils, determine the principles to be maintained in health resorts, especially in the field of construction, maintenance and operation. The statutes further determine the measures to be taken in a health resort in order to protect the treatment regime, hygienic qualities of the air, water and soil, to improve the ambience of the spa and to maintain or create the character of a health resort.

The protection of natural healing sources is provided for by setting up protection zones and by other protective measures. In our case, the subject of protection is the source of healing mineral water, in general. The measures taken protect the sources of mineral waters against human activity, especially against agricultural activity, which could disturb or have a negative impact on the discharge, physical properties, chemical composition or hygienic purity of natural healing sources, as well as of the entire hydrogeological structure.

Sources of mineral waters can be negatively influenced above all by ground or surface artificial interventions to the dynamics of the ground waters' natural regime. Such interventions can be: works subject to the mining law, deep drilling, excavating (digging of construction foundations, wells, equipment for exploiting and depositing carbohydrates, gravel and sand extraction), excavations, fills, dumps, polluting of surface waters by intensive agricultural, industrial, water-management activity, ground and surface mining, mining and blasting works.

The protection of natural healing sources has to be decided case by case and based on extensive knowledge of the geological and hydrogeological conditions of the en-

ture hydrogeological structure of the individual sources of mineral water, its genesis, type, gas content and chemical composition. Protection of mineral waters is provided for in four degrees:

1. *Internal protection*
2. *External protection*
3. *Protection of properties and products of a source of mineral water as a balneo-therapeutic agent*
4. *Protection of health resorts*

The first two degrees of the protection of mineral waters are provided for by the hydrogeological service, the third one by balneo-technical service and the fourth one by the State Administration bodies.

Internal Protection of Mineral Waters

The internal protection of mineral waters is a protection of the hydrogeological existence of the source. That means that the problems of protection of mineral waters' source are to be resolved at the very start of the hydrogeological research and prospecting studies. One of the decisive factors of this degree of protection is a correct and properly focussed execution of research and prospecting works, as well as their proper assessment. If we have a good knowledge of the origin of the mineral water, the character of the structure, exact quality and quantity of dissolved solids and gasses, we can approach a rational tapping, exploitation and distribution of the mineral water. That means that the internal protection of mineral water is linked to research studies connected to the tapping of the source, as well as the operation of the catching device itself, which aim at obtaining a new source. They are interventions to outlets of mineral and thermal waters directly in the centre of the discharge area.

Another significant factor of the internal protection of mineral waters is the type of their tapping. The correct tapping has to fulfil one goal - to collect the mineral water without losses and without changes to their physical and chemical properties. Choosing the tapping type the source should depend on the source's character, its social value in the discharge area, the investment costs and the technology available. The proposed way of tapping and distributing the mineral water has to comply with the principles of balneo-techniques and krenotechniques.

One of the most important factors, directly connected to the internal protection of mineral waters is the setting of an optimum withdrawal volume of mineral water and the withdrawal regime. It is necessary to provide for such conditions of hydrogeological structure, or its part, under which the source will deliver mineral water of required quality. An incorrect setting of optimum withdrawal volume can cause changes to:

- physical and chemical properties of water and a change to balance states between the individual components of mineral water,
- pressures on catching devices and to monitoring equipment,
- gas content,
- piezometric levels around catching devices,
- discharge of the mineral water's source.

The most frequent consequence of exceeding the limit of mineral water's withdrawal is a decrease in the piezometric level of mineral water to such an extent that the catching devices are encroached by regular ground waters, which produces a change in the quality of the mineral water.

A hydrodynamic test and its assessment is an important basis for setting the optimum withdrawal amount of mineral water, both from individual sources and from hydrogeological structure or its part. If the withdrawal limit is exceeded for a long period of time, the source as a whole can be damaged. This is the reason why constant monitoring of hydrogeological, hydrological, physical, chemical and other characteristics of the sources is one of the basic duties of the source's user. The basic facts that have to be monitored are the source's discharge, the ground water level, the water temperature, the gas content and determining the quantity of characteristic ions. For this purpose, a qualified monitoring service is established, which also has to monitor the mutual relations between the ground water regime and the climate. The extent and time intervals of the monitoring are determined according to individual characteristics of each source. Data obtained from this monitoring can be the first indicator of potential damage to the source.

Research and prospecting works executed directly in the discharge area of mineral waters are part of the most direct interventions in their regime. Therefore, they have to be prepared accurately. The research studies can only start after approval by the Slovak Health Ministry's Inspectorate of Spas and Mineral Springs. Through research and prospecting works it is necessary to provide for:

- documentation of the lithostratigraphic character of the drilled minerals and of all water saturated horizons,
- hydrodynamic tests,
- determining hydraulic properties of individual water saturated horizons, physical, chemical and other properties of waters, their mutual relations as well as changes to these characteristics during the course of performing the investigation,
- measuring of the amount of free gasses,
- immediate cessation of prospecting works in the case of a possible sudden release of pressure of ground waters and gasses that could damage the regime of mineral waters,
- permanent usage of prospecting works for spas or for bottling purposes
- closing down of prospecting works with the maintaining of original hydrogeological conditions of the regime of mineral waters' sources.

The internal protection of mineral waters also involves resolving the changes to physical and chemical composition of mineral water resulting from any interaction with the material from which catching devices and water transporting pipes are made, such as corrosion and salt deposition.

External Protection of Mineral Waters

The external protection of mineral waters represents protection against human activity near the sources of mineral waters. It provides for the protection of the entire hydrogeological structure, or a part of it, against all unde-

sirable interventions. External protection is a protection of the entire territory involved in using mineral waters. The potential and existing sources of depreciation of the environment and of pollution of mineral water are:

- factories causing air pollution (CO₂, SO₄, ash, soot etc.) especially around big industrial agglomerations and cities,
- factories producing waste,
- production, storage and transport of harmful substances,
- settlement agglomerations, but also private houses, especially agricultural settlements,
- dumps of waste and of leaching-predisposed substances,
- mining activity, gravel and sand excavation, stone-quarries devastating soil, uncovering the ground waters' level, transportation and transportation-connected operations, parking sites,
- agricultural activity, using of industrial fertilisers and insecticides, silage pits etc.,
- irrigation by harmful water,
- regulation of surface flows, floods,
- canalisation and related water treatment plants,
- waste water channels, desolated shafts, channels, wells, camp sites, playgrounds, insufficient hygienic equipment of cottages colonies and other sources of pollution,
- works requiring the use of explosives.

Melioris - Krahulec, 1993 divide the protection of hydrogeological structures with mineral waters into:

- *protection of discharge area*
- *protection of transit and accumulation area*
- *protection of infiltration area*

On the bases of this division, protection zones are set in three degrees:

• **protection zone of the first degree** protects the discharge area – the area where the mineral waters reach the earth surface in natural springs or are collected in boreholes. Declared protective measures aiming at providing for the stability of quantitative and qualitative parameters of mineral waters have to be maintained in this area.

In this type of protection zone it is prohibited to:

- a) *establish waste and toxic substances dumps*
- b) *built structures destined at agricultural and chemical production*
- c) *perform agricultural activity*
- d) *pour halite on roads*
- e) *perform any activity which can have a negative impact on physical properties, chemical composition or harmlessness of the natural healing sources or sources of mineral-rich potable waters*
- f) *without a binding expert opinion from the Slovak Health Ministry to:*

- transport or store oil, combustibles and chemical substances,
- perform drainage or irrigation works, a melioration, withdrawal of ground waters, drilling, blasting and digging,
- perform mining activity or activity related to mining way according to a special provision,
- perform unplanned wood cutting, gravel and soil mining.

• **Protection zone of 2nd degree** protects the area of formation, accumulation and movement of mineral water in its rock environment. Without having a binding opinion from the Slovak Health Ministry, in this area it is prohibited to:

- a) *establish waste and toxic substances dumps*
- b) *transport and store oil, combustibles and chemical substances*
- c) *drill boreholes deeper than 6 metres*
- d) *perform mining activity or activity linked to mining according to a special provision*
- e) *perform unplanned wood cutting, gravel and soil mining*
- f) *permit the withdrawal of and withdraw mineral waters at a total of more than 0.5l/s*

• **Protection zone of 3rd degree** protects the area of infiltration of atmospheric precipitation into the rock environment, where the precipitation contributes to circulation and formation of mineral water. Unless holding a binding permit from the Slovak Health Ministry, in this protection zone it is prohibited to:

- a) *cut more wood than approved in the plan of forest economy*
- b) *perform mining activity and activity linked to mining according to a special provision*
- c) *perform activities, which can have a negative impact on the area's infiltration regime*

Protection zones also provide for hygienic protection of the source. If the hygienic protection of the source requires setting of further measures and the protection zones are not sufficient for providing for the protection of the source, such measures can be set by agencies of the hygienic and anti-epidemiological service after an agreement with the Slovak Health Ministry. The special measures are especially important for natural healing sources, used for drinking treatment, or for sources of mineral-rich potable water, which do not have a deep circulation and are caught in place of their natural outlets.

The Slovak Health Ministry can decide to take temporary protection measures in order to protect the natural healing sources in a period without determined protection zones or other protective measures. These measures usually include setting *temporary protection zones*, delimited under conditions similar to those of the definitive protection zones. They are set in two degrees – as a narrow protection zone, which usually coincides with the protection zone of the first degree and as a wide protection zone, which is a substitute for the protection zones of the second and third degree.

In 1959 the State Administration worked out "Proposals for Temporary Protection Zones" based on the directives for drilling operations, works subject to mining law and other earth-moving projects in areas surrounding natural healing sources, issued by the Health Ministry and the Central Geological Office, published in the Official Bulletin, Section 51, from 1959. The proposals for temporary protection zones were worked out according to the state of geological and hydrogeological data and knowledge (Franko, 1959; Tkáčik, 1959) for the following spas

and bottling companies (the declaring of temporary protection zones were only gradually set by a ruling of the Health Ministry Commissioner during the following years) - *Sivá Brada-Baldovce, Bardejov, Brusno, Cigellka, Lúčky, Vyšné Ružbachy, Rajecké Teplice, Sklené Teplice, Salvator-Lipovce, Korytnica, Nosice-Nimnica, Sliač-Kováčová, Dudince-Slatina-Santovka-Malinovec, Sobrance, Rojkov (peloides deposit), Oravská Polhora, Bojnice.*

On the basis of the Resolution of the Government of the Slovak Socialist Republic 56/1974 extensive hydrogeological prospecting, aimed at delimiting protection zones of natural healing sources and natural mineral-rich potable waters was undertaken in: *Bardejovské kúpele, Brusno, Budiš, Cigellka, Číž, Dudince, Korytnica, Kováčová, Lipovce-Salvator, Lúčky, Martin-Fatra, Poltár-Maštinec, Rajecké Teplice, Sklené Teplice, Santovka, Slatina, Sliač, Smrdáky, Sobrance, Šafárikovo-Tornaľa, Trenčianske Teplice, Turčianske Teplice, Vyšné Ružbachy.*

Hydrogeological prospecting studies resulting from the Act No. 20/1996, Coll. and the Decree No.15/1972, Coll. represent another aspect of resolving the problems of protection and development of natural healing and potable waters. Solutions to problems, such as amendments to registrations and revision of registration of mineral and thermal waters, determination of contaminating substances, assessment of the mineral waters' regime in selected localities, have been proposed. These studies focus on obtaining data necessary for declaring permanent protection zones of natural healing sources and natural sources of mineral-rich potable waters.

Protection of Properties and Products of Mineral Water Source as balneo-therapeutic agent

Balneo-technology deals with the protection of properties and products of a source of mineral water acting as a balneo-therapeutic agent until any given treatment is finished, or until the water from the source starts to be used for drinking as potable water. This is based on one of the basic properties of natural healing sources – they can be used for healing purposes only in the state in which they occur in the nature, or after a modification, which will not interfere with their healing effects. Technical measures providing for the transport of natural healing sources from the site of occurrence to the place of application have to prevent the water's characteristics which have pharmaco-dynamic effects from decreasing under the determined limit values after the healing procedure is concluded.

Protection of Spa Resorts' Environment

Protection of the spa resorts' environment is an inseparable part of the protection of natural healing sources and is provided for by statutes of a spa, protection zones and other protective measures taken by the Government in order to protect significant spa resorts. Natural healing spas are established by the Health Ministry on the site of occurrence of natural healing sources or ambience fa-

vourable for healing, which are used for the purposes of spa treatment. Only natural sources declared healing can be used for the spa treatment (Slovak Parliamentary Act 277/1994, Coll., Art. 59, 60, Section 9)

Statutes of a spa delimit the activities in the given area:

- in a delimited internal territory of the health resort (internal health resort) only facilities serving the operation of the spa shall be established and operated,
- in the remaining part of the health resort (external health resort) factories, and other facilities shall be established only if they do not interfere with the spa treatment and with the environment of the health resort,
- in the health resort measures necessary for hygienic protection of air, water and soil, protection against noise and quakes and measures aiming at improving the overall atmosphere and appearance of the health resort shall be taken.

If the protective measures set in the statute of a spa are not sufficient for the protection of the natural healing spas, and it is necessary to protect the spas also through the more extensive surroundings of the health resort (to eliminate the effects, which could threaten or worsen the spa treatment or the air purity), protective measures shall also be set beyond of the area of the health resort. In case a protection of a wider extent is necessary, protection zones will be delimited around the health resort. The aforementioned protective measures will ban or limit the activity that threatens natural healing spas. Another alternative is to issue regulations on performing economic activity so that it does not worsen the conditions of the treatment in a spa. If needed, further protective measures, even beyond the protective zones, shall be set in order to protect natural healing spas.

Natural Therapeutic Spas

Slovak natural healing spas have a long-lived tradition. The healing effects of mineral waters to the man were known since time immemorial. In the past, mineral waters in small local spas healed various illnesses; however, they were even more important because of their recreational and rehabilitative activities. Small spas of local character such as *Veľatý, Byšta, Sobrance, Gánovce, Hodejov, Chalmová, Malé Bielice, Smerdžonka, Nová Ľubovňa, Myšľa, Kelča, Išľa, Cemjata, Sabinov, Cigellka, Baldovce, Ľubica, Hajnačka, Želovce, Kráľová, Badín, Bacúch, Pukanec, Liptovská Štiavnica, Oravská Polhora, Pezinok, Jur pri Bratislave* were gradually closed down.

At present, there are 18 therapeutic spas using mineral waters for therapeutic purposes - *Slovenské liečebné kúpele a.s., Bardejovské kúpele (Slovak Therapeutic Spas, joint stock company, Bardejov Spas), Kúpele Bojnice a.s. (Bojnice Spas), Horehronská liečebná spoločnosť a.s. Brusno (Upper Hron Therapeutic Association Brusno), Liečebný ústav Šamorín-Čilistov (Therapeutic Institute Šamorín-Čilistov), Prírodné liečivé kúpele a.s. Číž (Natural Therapeutic Spas Číž), Honttherma a.s. Dudince, Fatranské liečivé kúpele, a.s. Korytnica (Fatra Therapeutic Spas Korytnica), Kúpele Sliač a Kováčová,*

Table 1: Current state of protection of natural therapeutic spas in Slovakia

No.	Spa	Declared temporary protection zones	Protection zones (hydrogeological research)	Declared permanent protection zones
1	Bardejovské kúpele	yes	yes	recommended
2	Bojnice	---	yes	yes
3	Brusno	yes	yes	recommended
4	Čilistov	yes	no	---
5	Číž	yes	yes	recommended
6	Dudince	yes	yes	recommended
7	Kováčová	yes	yes	recommended
8	Korytnica	yes	under preparation	---
9	Lúčky	yes	under preparation	---
10	Nimnica	---	---	yes
11	Piešťany	---	---	yes
12	Rajecké Teplice	yes	yes	recommended
13	Sklené Teplice	yes	yes	recommended
14	Sliač	yes	yes	recommended
15	Smrdáky	yes	yes	recommended
16	Trenčianske Teplice	yes	under preparation	---
17	Turčianske Teplice	yes	yes	recommended
18	Vyšné Ružbachy	yes	yes	recommended

Table 2 Current state of protection of used sources of mineral-rich potable waters

Bottling company – mineral water	State of protection	Declared temporary protection zones	Protection zones (hydrogeological research)	Declared permanent protection zones
Baldovce – Baldovská	declared	yes	yes	recommended
Budiš – Budiš	declared	yes	under preparation	recommended
Cigelfka – Cigelfka	declared	yes	yes	recommended
Čačín - Aqua prima	declared	yes	no	---
Korytnica – Korytnica	declared	yes	under preparation	recommended
Lipovce-Salvator – Salvator	declared	yes	yes	recommended
Martin-Záturčie – Fatra	declared	yes	yes	recommended
Santovka – Santovka	declared	yes	yes	recommended
Slatina – Slatina	declared	yes	yes	recommended
Tornaľa – Magnerad	declared	yes	under preparation	recommended

a.s. (Kováčová) (Kováčová and Sliač Spas), Liptovské liečebné kúpele a.s. (Liptov Therapeutic Spas), Kúpele Nimnica a.s. (Nimnica Spas), Slovenské liečebné kúpele a.s. Piešťany (Slovak Therapeutic Spas Piešťany), Vojenský kúpeľný ústav Piešťany (Military Spa Institute Piešťany), Slovenské liečebné kúpele a.s. Rajecké Teplice (Slovak Therapeutic Spas Rajecké Teplice), Liečebné termálne kúpele a.s. Sklené Teplice (Therapeutic Thermal Spas Sklené Teplice), Kúpele Sliač a Kováčová a.s. (Sliač), Slovenské liečebné kúpele a.s. Piešťany - Smrdáky (Slovak Therapeutic Spas Piešťany - Smrdáky), Slovenské liečebné kúpele a.s. Trenčianske Teplice (Slovak Therapeutic Spas Trenčianske Teplice), Slovenské liečebné kúpele a.s. Turčianske Teplice (Slovak Therapeutic Spas Turčianske Teplice), Kúpele Vyšné Ružbachy a.s. (Vyšné Ružbachy Spas), along with 5 climatic spas – Detská liečebňa Horný Smokovec a.s.

(Children's Medical Institution Horný Smokovec), Kúpele Lučivná a.s. (Lučivná Spas), Kúpele Nový Smokovec a.s. (Nový Smokovec Spas), Kúpele Štós a.s. (Štós Spas), Kúpele Štrbské Pleso a.s. (Štrbské Pleso Spas), which foster a favourable ambience. The current state of protection of natural therapeutic spas is presented in table 1.

Activities in the spa area requiring a binding expert opinion from the Slovak Health Ministry:

- approving of documentation of territorial planning, which concerns health resorts or their protection zones,
- issuing of territorial decisions and building permits for the construction in internal areas of health resorts, in the protection zone of the first degree, or in narrow temporary protection zone of natural therapeutic sources, for constructions in external natural health resort and protection zone of the second and third degree or in a wide protection zone of natural therapeutic sources, which do

Table 3 Current state of protection of prospective sources of mineral waters

Bottling company – mineral water	State of protection	Declared temporary protection zones	Protection zones (hydrogeological research)	Declared permanent protection zones
Kláštôr pod Znievom-Kláštorná	declared	yes	no	---
Klokoč-Klokočina	declared	yes	no	---
Nová Ľubovňa-Veronika	declared	yes	under preparation	---
Mošovce	undeclared	no	no	---
Sulín-Sulínka	declared	yes	no	---
Trenčianske Mitice	undeclared	no	no	---
Liptovská Štiavnica	declared	yes	no	---

Table 4: Outline of registered mineral and thermal waters in Slovakia

District	before 1969	1969	1972	1979	1980	1983	1988	1990	1992	1994	1995	1996	1997	Total
Banská Bystrica	73	4		6	1	3	2	2						91
Bardejov	89	7	10	1	1		1				7		3	119
Bratislava	2				3			2						7
Čadca	3									7	1			11
Dolný Kubín	34		1	1	1					3	3			43
Dunajská Streda	0		1	1	2	1	1	3	6					15
Galanta	1				3	3	1		2					10
Humenné	24	1	1		1						4			31
Komárno	6	1	2	1	2	1	2	2	2					19
Košice	7	1									1			9
Levice	28	4	4	5	3	2	2	4	3					55
Liptovský Mikuláš	158	5	8	4	6	5	1	4				4		195
Lučenec	70	4	3				1				3			81
Martin	24	10	2	5	1	1		8		5		2	1	59
Michalovce	14	3			3									20
Nitra	0					2		1		1				4
Nové Zámky	1				2	1		2		4				10
Poprad	118	1	1	10	7	1				2		1	2	143
Považ. Bystrica	22	2	2	9			4	1			1			41
Prešov	98	2	5				3				6			114
Prievidza	20			2		1	2	5		2				32
Rimav. Sobota	70	3	3				3			4		1	7	91
Senica	22		1	3	3	1		4		2				36
Spišská N. Ves	23	4	3	1							2		1	34
Stará Ľubovňa	0	1		4	5	1	1	3			2	2	2	21
Svidník	0	3		7	1						1			12
Topoľčany	16		1	1	2	1	2	1						24
Trebišov	9		1		1					1	1			13
Trenčín	76	6	6	2			3	4		1		2	1	101
Trnava	13	4		5	2	2	2	4						32
Veľký Krtíš	0		1	2									1	4
Vranov	0				1									1
Zvolen	72	1	2	3	2	3		4		5	3	2		97
Žiar n. Hronom	27	3		1		2		1			2			36
Žilina	14		8	6	1		1	2		1				33
Total	1134	70	66	80	54	31	32	30	13	38	37	14	18	1644

Table 4 was worked out on the basis of following works: Bergerová – Halas, 1995; Bergerová – Vandrová – Halas, 1992; Rebro et al., 1969; Rebro et al., 1972; Rebro et al., 1979; Rebro et al., 1980; Rebro et al., 1983; Tkáčik, 1963, 1967; Tkáčik et al., 1967; Tkáčik et al., 1967a; Tkáčik et al., 1969; Tkáčik et al., 1969a; Tkáčik – Jakab, 1961a; Tkáčik – Jakab, 1961b; Tkáčik – Jakab, 1961c; Tkáčik – Jakab, 1961d; Tkáčik – Jakab, 1961e; Tkáčik – Jakab, 1961f; Tkáčik – Jakab, 1961g; Tkáčik – Jakab, 1961h; Tkáčik – Jakab, 1962; Tkáčik – Jakab, 1962a; Tkáčik – Jakab, 1962b; Tkáčik – Jakab, 1965; Tkáčik – Jakab, 1966; Tkáčik – Jakab, 1966a; Tkáčik – Jakab, 1966b; Tkáčik – Jakab, 1967; Tkáčik – Jakab, 1967a; Tkáčik – Jakab, 1967b; Tkáčik – Jakab, 1961c; Vandrová, 1990; Vandrová, 1990a; Vandrová – Bergerová, 1994; Vandrová – Halas, 1996; Vandrová – Rebro, 1988

not have a character of public facilities or of house-building, performed in a maximum depth of 6 metres and according to approved documentation of territorial planning for the construction of a cottage colony and recreational area in a health resort;

- issuing of water-management permits for the construction of equipment for ground water withdrawal in protection zones of natural therapeutic sources;
- issuing of permits for studies subject to mining law and to similar activities in protection zones of natural therapeutic sources.

Current state of usage and protection of mineral waters

There are 10 bottling companies in Slovakia (Franko-Melioris, 1999), which use sources of mineral-rich potable waters or of natural healing sources *Minerálne vody a.s. Prešov, závod Baldovce* (Mineral Waters, joint stock company, Prešov, factory Baldovce); *Stredoslovenské žriedla a.s. Martin, závod Budiš* (Central Slovakian Springs, Martin, factory Budiš); *Minerálne vody a.s. Prešov, závod Cigelka* (Mineral Waters Prešov, factory Cigelka); *Fatranské liečebné kúpele a.s. Korytnica* (Fatra Therapeutic Spas Korytnica); *Minerálne vody a.s. Prešov, závod Lipovce-Salvator* (Mineral Waters Prešov, factory Lipovce-Salvator); *Minerálne vody Čerín, spol. s r.o. (Mineral Waters Čerín, Ltd.)*; *Stredoslovenské žriedla a.s. Martin, závod Záturčie-Fatra* (Central Slovakian Springs Martin, factory Záturčie-Fatra); *Západoslovenské žriedla a.s. Santovka* (Western Slovakian Springs, Santovka); *Geminal spol. s r.o. Tornaľa* (Geminal Ltd, Tornaľa); and 5 localities aiming at building a bottling company - *Novex Martin, Ltd.*; *Klokočina Ltd. Klokoč*; *Local Office Nová Ľubovňa, Sulín Minerálna voda s.r.o. (Mineral Water Sulín, Ltd.)*; *Liptovská Štiavnica* and other localities with sources of mineral water which could potentially be bottled (*Maštinec, Mošovce, Trenčianske Mitice*). The current state of protection of used natural healing sources and sources of mineral-rich potable waters is presented in table 2. Table 3 presents protection of prospectively used sources.

Organisations performing drilling, works which are subject to mining act and other earth-moving projects are obliged to announce the finding of a new source of mineral and thermal water to the Inspectorate of Spas and Mineral Springs within 15 days. The Inspectorate of Spas and Mineral Springs registers all sources of mineral and thermal waters, gasses and emanations, which have not been declared for healing sources or sources of mineral-rich potable waters, and rules on its category designations, usage and protection. Table 4 presents an outline of registered mineral and thermal waters in individual Slovak districts and their year of the registration.

In order to intensify and make the protection of the natural healing sources and natural sources of mineral-rich potable waters more effective, data for declaring permanent protection zones are worked out on the basis of the latest geological, tectonic and hydrogeological

knowledge obtained through the results of prospecting hydrogeological explorations performed in compliance with the Government's regulation No. 56/1974. An outline of declared natural healing sources and natural sources of mineral - rich potable waters is included in table 5.

The Inspectorate of Spas and Mineral Springs is obliged to check regularly the chemical, physical, microbiological and other determined parameters of the promulgated sources through the *Reference Centre for Protection and Development of Natural Therapeutic Spas and Natural Healing Mineral-rich Potable Waters*, based in Piešťany and established by the Slovak Health Ministry. The regular monitoring and assessing of the parameters is very important since the factual state of the measured values represents the state of the entire hydrogeological structure in which the individual types of mineral waters form, accumulate and reach the earth surface through various outlets. Substantial deviations in the data obtained by monitoring are the first indicators of a damage to the source, or of the pollution of infiltration or accumulation area of the source.

One of the tasks of the Slovak Health Ministry is to keep improving the legislative norms, which should eliminate the various activities, which have a negative impact on the therapeutic treatment in the spas, protection of natural healing sources, sources of mineral-rich potable water and favourable ambience.

Conclusion

It is possible to maintain the existence and properties of natural healing sources, sources of mineral-rich potable water as well as those of mineral and thermal waters in such a state, in which it is possible to use them for therapeutic purposes or as a bottled, high-quality refreshing beverage only through the fulfilling of duties resulting from the aforementioned complex of legal norms and other protective documents.

References

- Bergerová, H. and Halas, G., 1995: Doplnky registrácie minerálnych a termálnych vôd na Slovensku č. 8 III. Archív INGEO a.s., Žilina.
- Bergerová, H., Vandrová, G. and Halas, G., 1992: Doplnky registrácie minerálnych a termálnych vôd na Slovensku č. 8. Archív INGEO a.s. Žilina.
- Franko, O., 1959: Návrh na dočasné ochranné pásma kúpeľov a žriediel na Slovensku. Archív Inšpektorátu kúpeľov a žriediel, Bratislava.
- Franko, O. and Melioris, L., 1999: Podmienky vzniku a rozšírenia minerálnych a termálnych vôd v Západných Karpatoch. Slovak Geological Magazine, 1,2-99. Geologická služba SR.
- Krahulec, P., 1972: Stručný vývoj právnych úprav rozvoja a ochrany kúpeľov. Právny obzor 6, roč. LV-1972, SAV Bratislava, 531-542.
- Melioris, L. and Krahulec, P., 1993: Súčasný stav využívania a ochrany minerálnych vôd na Slovensku. Zborník vedeckej konferencie „Vodné zdroje a ich ochrana“, STU, Bratislava, 57-70.
- Melioris, L. - Mucha, I. and Pospíšil, P., 1986: Podzemná voda - metódy výskumu a prieskumu. Alfa - SNTL, Bratislava.
- Rebro, A., Klagó, M., Matejčeková, E., Jurdík, M. and Židek, L., 1979: Registrácia minerálnych a termálnych vôd na Slovensku - doplnky č. 3. Archív INGEO a.s., Žilina.
- Rebro, A., Klagó, M., Repiecška, G. and Židek, L., 1983: Doplnky registrácie minerálnych a termálnych vôd na Slovensku č. 5. Archív INGEO a.s., Žilina.

Table 5: Outline of declared natural healing sources and natural sources of mineral-rich potable waters

Locality	Source	Declared
Baldovce	Baldovce II BV-1	source of mineral-rich potable water
	Borehole BV-4/A	source of mineral-rich potable water
Bardejovské kúpele	Anna BJ-21	natural healing source
	Napoleon BJ-18	natural healing source
	Klára BJ-20	natural healing source
	Alžbeta BJ-24	natural healing source
	Hlavný prameň (Main spring)	natural healing source
	Lekársky prameň (Medical spring)	natural healing source
	Herkules S-8	natural healing source
	Alexander BKH-3	natural healing source
	Kolonádny prameň (Colonnade spring) BJ-19	natural healing source
	František BKH-1	natural healing source
Bojnice	Borehole BR-1 (Jesenius)	natural healing source
	Borehole Z-2 Starý prameň (Old spring)	natural healing source
	Borehole BR-2 Jazero (Lake)	natural healing source
	Borehole BR-3	natural healing source
Brusno	Pavla (Paula)	natural healing source
	Ondrej BC-1	natural healing source
	Eudovít (Ludwig)	natural healing source
	Ďumbier PJ-104	natural healing source
Budiš	Borehole B-4	source of mineral-rich potable water
	Borehole B-3	source of mineral-rich potable water
Cigelfka	Cigelfka VIII CH-1	natural healing source
Čačín	Borehole ČAM-1	source of mineral-rich potable water
Čilistov	Borehole FGČ-1	natural healing source
Číž	Hygiea	natural healing source
Dudince	Spa borehole S-3	natural healing source
Kláštôr pod Znievom	Kláštorný (Monasterial) KM-1	source of mineral-rich potable water
Klokoč	Borehole VBK-1	source of mineral-rich potable water
Korytnica	Jozef	natural healing source
	Žofia	natural healing source
	Vojtech II	natural healing source
	Vojtech I	natural healing source
	Klement S-7	natural healing source
	Borehole BJ-2/A	natural healing source
Kováčová	Borehole K-2	natural healing source
Lipovce-Salvator	Salvátor II	source of mineral-rich potable water
	Salvátor I	source of mineral-rich potable water
Lúčky	Valentína BJ-101	natural healing source
	Borehole BLK-2 Spa II	natural healing source
Martin-Záturčie	Fatra II BJ-2	source of mineral-rich potable water
Nimnica	Prameň mládeže (Spring of the Youth) B-1	natural healing source
	Borehole B-8	natural healing source
	Borehole B-7	natural healing source
	Borehole B-9	natural healing source
Nová Ľubovňa	Veronika LZ-6	source of mineral-rich potable water
Piešťany	Hynie V-4a	natural healing source
	Torkoš V-8	natural healing source
	Scherer V-9	natural healing source
	Crato V-10	natural healing source

Locality	Source	Declared
Piešťany	Trajan	natural healing source
	Borehole VLÚ-1	natural healing source
	Cmunt V-1	natural healing source
	Beethoven V-7	natural healing source
	Borehole PS-1 (Slovan)	natural healing source
	Borehole PS-4 (Slovák)	natural healing source
	Borehole PS-2 (Sláv)	natural healing source
	Borehole PS-3 (Sloven)	natural healing source
Rajecké Teplice	Borehole BJ-22	natural healing source
	Mužský bazén (Men's Pool) B-10	natural healing source
	Ženský bazén (Women's Pool) I B-3	natural healing source
	Ženský bazén (Women's Pool) II B-2	natural healing source
	Šachta v kotolni (Shaft in Boiler-room) V-1	natural healing source
	Borehole BJ-19	natural healing source
Santovka	Borehole B-15	source of mineral-rich potable water
	Santovka II B-9	source of mineral-rich potable water
	Santovka I B-6	source of mineral-rich potable water
	Santovka IV HG-4	source of mineral-rich potable water
Skléné Teplice	Born ST-2	natural healing source
	Banský (Mining)	natural healing source
	Zipser ST-1	natural healing source
	Ľudový (People's)	natural healing source
	Vojtech	natural healing source
	Jozef	natural healing source
Slatina	Slatina IV BB-1	source of mineral-rich potable water
	Slatina III S-II ST-2	source of mineral-rich potable water
	Slatina V BB-2	source of mineral-rich potable water
Sliač	Bystrica	natural healing source
	Štefánik	natural healing source
	Lenkey	natural healing source
	Adam	natural healing source
	Kúpeľný (Spa) I a	natural healing source
Smrdáky	Jozef I ST-2	natural healing source
	Jozef II Z-1	natural healing source
Šafárikovo (Tornaľa)	Borehole HVŠ-1	source of mineral-rich potable water
Trenčianske Teplice	Sina I V-2	natural healing source
	Letný prameň (Sommer Spring) SB-3	natural healing source
	Príma P-1	natural healing source
	Sina II V-3	natural healing source
	Wernher II SB-5A	natural healing source
	Wernher SB-5	natural healing source
	Tomáš SB-1	natural healing source
Turčianske Teplice	Ľudový (People's)	natural healing source
	Borehole TTM-2	natural healing source
	Borehole TTM-1	natural healing source
	Červený bazén (Red Pool)	natural healing source
	Modrý bazén (Blue Pool)	natural healing source
	Kollár B-2	natural healing source
	Živena TJ-3	natural healing source
	Materský (Maternal)	natural healing source
Vyšné Ružbachy	Borehole VR-2	natural healing source
	Izabela	natural healing source

- Rebro, A., Klagó, M. and Židek, L., 1980: Registrácia minerálnych a termálnych vôd na Slovensku - doplnky č. 4. Archív INGEО a.s., Žilina.
- Rebro, A., Malatinský, K. and Klagó, M., 1969: Výskum prameňov minerálnej vody na Slovensku - doplnky č. 1. Archív INGEО a.s., Žilina.
- Rebro, A., Malatinský, K., Klagó, M. and Záborský, J., 1972: Revízia registrácie minerálnych a termálnych vôd na Slovensku - doplnky č. 2. Archív INGEО a.s., Žilina.
- Tkáčik, P., 1959: Návrhy na dočasné ochranné pásma pre kúpele a žriedla Slovenska patriace pod Poverenieťvo zdravotníctva. Geofond, Bratislava.
- Tkáčik, P., 1963: Výskum prameňov minerálnej vody. Stredoslovenský kraj, okres Liptovský Mikuláš. Archív INGEО a.s., Žilina.
- Tkáčik, P., 1967: Výskum prameňov minerálnej vody. Západoslovenský kraj, okres Senica. Archív INGEО a.s., Žilina.
- Tkáčik, P., 1975: Podklady pre revíziu dočasných užších ochranných pásiem prírodných liečivých zdrojov SSR. Archív INGEО a.s., Žilina.
- Tkáčik, P. and Jakab, A., 1961a: Registrácia prameňov minerálnej vody. Stredoslovenský kraj, okres Považská Bystrica. Archív INGEО a.s., Žilina.
- Tkáčik, P. and Jakab, A., 1961b: Registrácia prameňov minerálnej vody. Stredoslovenský kraj, okres Martin. Archív INGEО a.s., Žilina.
- Tkáčik, P. and Jakab, A., 1961c: Registrácia prameňov minerálnej vody. Stredoslovenský kraj, okres Dolný Kubín. Archív INGEО a.s., Žilina.
- Tkáčik, P. and Jakab, A., 1961d: Registrácia prameňov minerálnej vody. Stredoslovenský kraj, okres Žilina, Čadca. Archív INGEО a.s., Žilina.
- Tkáčik, P. and Jakab, A., 1961e: Registrácia prameňov minerálnej vody. Východoslovenský kraj, okres Michalovce. Archív INGEО a.s., Žilina.
- Tkáčik, P. and Jakab, A., 1961f: Registrácia prameňov minerálnej vody. Východoslovenský kraj, okres Prešov. Archív INGEО a.s., Žilina.
- Tkáčik, P. and Jakab, A., 1961g: Registrácia prameňov minerálnej vody. Východoslovenský kraj, okres Bardejov. Archív INGEО a.s., Žilina.
- Tkáčik, P. and Jakab, A., 1961h: Registrácia prameňov minerálnej vody. Východoslovenský kraj, okres Humenné. Archív INGEО a.s., Žilina.
- Tkáčik, P. and Jakab, A., 1962: Výskum prameňov minerálnej vody. Východoslovenský kraj, okres Poprad. Archív INGEО a.s., Žilina.
- Tkáčik, P. and Jakab, A., 1962a: Výskum prameňov minerálnej vody. Východoslovenský kraj, okres Spišská Nová Ves. Archív INGEО a.s., Žilina.
- Tkáčik, P. and Jakab, A., 1962b: Výskum prameňov minerálnej vody. Východoslovenský kraj, okres Košice, Trebišov. Archív INGEО a.s., Žilina.
- Tkáčik, P. and Jakab, A., 1965: Výskum prameňov minerálnej vody. Stredoslovenský kraj, okres Žiar nad Hronom. Archív INGEО a.s., Žilina.
- Tkáčik, P. and Jakab, A., 1966: Výskum prameňov minerálnej vody. Stredoslovenský kraj, okres Lučenec. Archív INGEО a.s., Žilina.
- Tkáčik, P. and Jakab, A., 1966a: Výskum prameňov minerálnej vody. Stredoslovenský kraj, okres Rimavská Sobota. Archív INGEО a.s., Žilina.
- Tkáčik, P. and Jakab, A., 1966b: Výskum prameňov minerálnej vody. Stredoslovenský kraj, okres Banská Bystrica. Archív INGEО a.s., Žilina.
- Tkáčik, P. and Jakab, A., 1967: Výskum prameňov minerálnej vody. Stredoslovenský kraj, okres Zvolen. Archív INGEО a.s., Žilina.
- Tkáčik, P. and Jakab, A., 1967a: Výskum prameňov minerálnej vody. Západoslovenský kraj, okres Trenčín. Archív INGEО a.s., Žilina.
- Tkáčik, P. and Jakab, A., 1967b: Výskum prameňov minerálnej vody. Západoslovenský kraj, okres Galanta, Komárno. Archív INGEО a.s., Žilina.
- Tkáčik, P. and Jakab, A., 1967c: Výskum prameňov minerálnej vody. Západoslovenský kraj, okres Trnava. Archív INGEО a.s., Žilina.
- Tkáčik, P., Klagó, M. and Jakab, A., 1967: Výskum prameňov minerálnej vody. Západoslovenský kraj, okres Bratislava, Nové Zámky, Nitra. Archív INGEО a.s., Žilina.
- Tkáčik, P., Klagó, M. and Jakab, A., 1967a: Výskum prameňov minerálnej vody. Západoslovenský kraj, okres Levice. Archív INGEО a.s., Žilina.
- Tkáčik, P., Malatinský, K. and Klagó, M., 1969: Výskum prameňov minerálnej vody. Západoslovenský kraj, okres Topoľčany. Archív INGEО a.s., Žilina.
- Tkáčik, P., Rebro, A. and Klagó, M., 1969: Výskum prameňov minerálnej vody. Stredoslovenský kraj, okres Prievidza. Archív INGEО a.s., Žilina.
- Vandrová, G., 1990: Doplnky registrácie minerálnych a termálnych vôd na Slovensku č. 7, časť B. Archív INGEО a.s., Žilina.
- Vandrová, G., 1990a: Doplnky registrácie minerálnych a termálnych vôd na Slovensku č. 7, časť A. Archív INGEО a.s., Žilina.
- Vandrová, G. and Bergerová, H., 1994: Doplnky registrácie minerálnych a termálnych vôd na Slovensku č. 8 II. Archív INGEО a.s., Žilina.
- Vandrová, G. and Halas, G., 1996: Doplnky registrácie minerálnych a termálnych vôd na Slovensku č. 8 IV. Archív INGEО a.s., Žilina.
- Vandrová, G. and Rebro, A., 1988: Doplnky registrácie minerálnych a termálnych vôd na Slovensku č. 6. Archív INGEО a.s., Žilina.