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OF THE ACADEMY OF SCIENCES
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Kazakh national research technical university
named after K. I. Satpayev

ГЕОЛОГИЯ ЖӘНЕ ТЕХНИКАЛЫҚ ҒЫЛЫМДАР СЕРИЯСЫ

♦

СЕРИЯ ГЕОЛОГИИ И ТЕХНИЧЕСКИХ НАУК

♦

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BIOCLIMATIC CONDITIONS OF CLIMATIC THERAPY ON THE COAST OF THE LAKE INDER OF THE REPUBLIC OF KAZAKHSTAN

Abstract. The article presents the results of the research of bioclimatic peculiarities on the coast of lake Inder (the Republic of Kazakhstan) on the basis of which the bioclimatic potential of this territory (2,25 points from 3,0 possible) has been estimated, and the category of its compliance for resort climatotherapy is high on condition that 60% is landscape gardening of the territory and building of a year-round climatic medical center. There have been developed some specific favourable bioclimatic features of this area (high purity of the ground atmosphere, the existence of biologically active ultra-violet solar radiation (with the wavelength of 290-315 nm) within a year, the existence of small doses of finely dispersed chlorhydric aerosol in the ground atmosphere, the increased level of natural aero ionization (till 1340 ion/cm^3) with a low coefficient of ion unipolarity (lower than 1,0), a long period with favourable conditions staying in the fresh air (280 days in a year). Bioclimatic conditions are favourable for organization year-round aero- and heliotherapies, natural aero ionization, terrainkur and recreational actions in the open air.

Key words: bioclimatic potential of the coast of lake Inder of the Republic of Kazakhstan, natural aero ionization, prospects of the organization of resort climatotherapy.

The relevance of the research is caused by the requirements of healthcare service of the Republic of Kazakhstan to develop resort medicine based on the use of natural medical resources (natural mineral waters, peloids, medical climate, recreational landscapes) as the most physiologic, highly effective, economically advantageous and available in application [1-3]. The question of construction on the coast of lake Inder (Atyrau region, Inderborsky territory) of the resort complex (RC) on the basis of usage of local natural medical factors (mineral waters, therapeutic muds, bioclimate) is being considered within the development of the sanatorium-and-health resort help to the population by Akimat of Atyrau region of the Republic of Kazakhstan.

Bioclimatic resources of the resort area are very important in the complex of natural medical resources, their naturalness, systemacity and physiology of influence. Usage of bioclimate features of the area in the treatment-and-prophylactic purposes has an advantage on medicinal therapy as climatic factors are habitual for the person, responses to them are fixed genetically, at their reasonable application there are no complications characteristic of medicinal therapy therefore they can be used for a long period of time, in courses and practically all life to temper, to train and to raise nonspecific resistance of an organism, to restore lost health, to increase life quality and duration of the period of active life [1, 4, 5].

The role of special methods of climatotherapy is especially high (air and solar baths, sleeping in the fresh air, medical terrainkur, medical swimming in the pool, health-improving rest in favorable bioclimatic conditions) at which there is a training of humoral, nervous and other mechanisms of thermal control, the vitality increases and adaptation opportunities of an organism extend. The use of climatotherapy makes synergistic positive impact on other resort treatment modalities promoting the increase in efficiency of

rehabilitation treatment [6, 7]. Climatotherapy promotes the development of a number of nonspecific and specific body reactions directed to its improvement, especially at chronic or slow pathological processes. Nonspecific action of climatic factors can be presented in such sequence: thermoadaptation change; optimization of exchange processes; change of nonspecific and specific body reactivity: increase in general immunoreactivity, phagocytic leukocytes activity, decrease in sensitization of an organism; optimization of functions of organs and systems [8 7].

The experience shows that it is necessary to observe the requirements to bioclimatic conditions and influence doses of environmental factors in compliance with methodical recommendations to obtain high efficiency of climatotherapy. In this regard, the special relevance is acquired by researches of bioclimatic mode of the resort area on the basis of which the program of resort climatotherapy is carried out.

The objective of this research was to study balneological potential of landscape elements and bioclimate in the area of the planned construction of the health resort Inder and the assessment of prospects of their use for organization of various methods of climatotherapy and climatolandscape therapy.

Materials and methods. There have been used some observational materials of the following meteorological stations: the mountain (since 1999 mountain village Akkala) located in 5 km to the north of the settlement of Inderborsky settlement (the height above the sea level is 0 m, the width is 48037′09″ north latitude, the longitude 51045′30″ east longitude), from 1937 to 1943; Taypak (till 1993 Kalmykovo), located in 62 km to the north of Inderborsky settlement (the height above the sea level is 2 m, the width is $49^0$05', the longitude is $51^0$87', meteorological index is WMO 35406) from 1926 to 2017; the materials of own stationary (Inderborsky settlement) and route observations on 6 platforms different in microlandscape, located in the area of the supposed placement of HR Inder. On the stationary point, the following parameters were defined: actinometrical conditions (the intensity of straight and total solar radiation with the subsequent calculation of transparency coefficient and turbidity factor), microclimatic conditions (temperature, humidity and air pressure, an amount of precipitation - continuous registration for the electronic media). Route observations included samples of microclimatic conditions (temperature and air humidity, atmospheric pressure, speed and direction of wind, quantity and form of clouds, atmospheric phenomena), concentration of light air ions of positive and negative charge (the mobility is $k > 0{,}5$ cm^2/V s) and also the visual assessment of orography, landscape and esthetic quality and comfort of the landscape for climatolandscape therapy purposes, description of vegetation species in the area of HR Inder.

The article deals with standard technologies of climate research, special complex assessment methods of climate and landscape for medical purposes [2, 4, 9, 10-13].

Research results

Landscape features of the territory of the supposed building of the health resort near lake Inder are caused by their location in the northern suburb of Caspian Plain in the western steppe semidesert part of the Republic of Kazakhstan on the bank of brine lake Inder. The area is a poor hilly steppe plain delimited by low (to 56 m above the sea level) flat bushlike ridges and barrows of open-casts (102 units) in the north where borates were produced and lake Inder in the East. Northern and northeasten banks of the lake border Indersky mountains (the maximum height is 54 m above the sea level). In geomorphological relation, the area is located within the plateau-like upland of Indersky dome fold rising over lake Inder by 15-25 m with a slight slope to the South. Wide expansion of low depositional plains is an important factor of active manifestation of processes of natural and anthropogenic desert advancing.

The soil cover of the considered territory is presented by generally light-chestnut soils for which it is characteristic to have a small capacity of humic layers with a small amount of humus – 2-3% (slightly humic), solonchak soils and alkali soils and is used mainly for poorly intensive grazing of animals (horses, cattle and camels).

In geographical relation, the area is located in typically flat monotonous area in a steppe zone with fescue-vermuth vegetation. The vegetative cover is generally made by drimophilus: sagebrush, fescue, common thistle, sea lavender, seepweed and others, in some places there are such plats as kochia, ebeleck, eurotia, orach, and needle grass among sagebrush. In the spring there are tulips (mainly Shrenk's and Greig's tulips included in the Red Book of Kazakhstan), steppe iris and other ephemers plants and efemeroids. The territory is characterized by natural cover in original state dislocated mainly by numerous holes of ground squirrels and automobile unmade roads.

In the East of the territory of the planned HR, there is a brine deposited terminal lake of the tectonic type Inder. The area of the mirror is about 110 square kilometers, the length is about 13,5 km, the width is about 10 km, the depth is to 56 m, the shape is rounded slightly extended from the northwest to the southeast. Lake recharge is generally underground (chlorhydric springs), snow and rain. In the lake the extraction of salt is being produced, the width of the salt layer is up to 15 m. The lake bottom is marshy covered with a layer of peloids (about 4 m), the brine of the lake has a high mineralization (about 300 g/m^3). Nowadays the brine and mud on the lake banks are used for a spontaneous balneo-mud-cure.

The territory of the supposed placement of HR Inder is not subject to flooding.

In the conditions of terrain uniformity the landscape attractiveness for resort and recreational use will depend on many factors including the qualified approach to the construction of the modern complex of medical and recreational buildings, composition methods in development of space; creation of an oasis of green wood and shrubby plantings with good decorative properties, high environment-forming, phytontsid, esthetic and sanitary and hygienic functions which have the ability to microclimate correction from strong winds that are cold in the winter and hot in the summer.

Bioclimatic capacity of the area is formed under the influence of major climate factors: solar radiation, atmospheric circulation, geological substrate and ecological features of the territory. An important climatic feature of the considered territory is the abundance of sunny days (up to 60% of days in a year are clear, and in summer months - up to 80%), high duration of sunshine (about 2500 hours a year on average), big inflow of solar heat (up to 11000 mJ/m^2 a year). Within a year there are up to 40 cloudy days on average, 90% of which fall in cold season. The territory belongs to the regions with abundant of ultraviolet (UV) solar radiation, the phenomena of UV deficiency are absent (at noon in the winter UVI is 0,3-1, in the summer to 9-10).

Climatic conditions of these places in an essential measure are caused by considerable removal from the oceans, lack of high mountain barriers, a flat arrangement in the north of Caspian Depression. It causes planetary circulation over the considered territory - air masses freely move both from the west to the east, and from the north to the south. At the western (lateral) circulation pattern there are latitudinal wedges of hypertension are established or there is a shift from the west to the east of anti-cyclonic systems moving through of low pressure, sometimes with atmospheric fronts. On average at the latitudinal circulation pattern, there is a sediment supply deficit and a raised temperature background.

At ingress of the Arctic air (generally in the winter) anti-cyclonic weather is set – slightly overcast and frosty. Air masses of temperate zone soften weather a little and bring the bulk of precipitation, but as on the way they lose a significant amount of humidity, there is little precipitation here. Subtropical and tropical air masses from Central Asia reach the North of Caspian Depression mainly in warm season establishing very hot dry weather in the summer and thaw in the winter. Humid air masses and monsoons from the Indian Ocean are blocked by mountains in the south.

The wind regime in the considered territory has a pronounced annual course. In winter time east and southeast winds (under the influence of the periphery of the western spur of Siberian anti-cyclone) prevail, in summer months - winds of northern bearings, and in off-season – west-eastern transfer. The average monthly wind speed fluctuates within 3,4-5,0 m/s (maximum in February, March, minimum – August, September). In all months of a year, the most probable speed of wind is 2-5 m/s (25-27% of the total number of cases). Daily average with strong wind (≥ 15 m/s) is 30 days, with dust storms - to 20 days.

According to climatic zonation, the considered territory is included into the zone with hot long summer (144 days on average) and cold, sometimes severe winter (about 136 days), spring (about 45 days) and fall (about 40 days) are short, differ in sharp change of the weather mode. Average annual amplitude on average monthly air temperature reaches 35^0C, and magnitude is about 90^0C (sharp continental climate). Average annual air temperature is about + 8^0C, in July about + 26^0C, in January near -9^0C. On average about 190 mm of precipitation fall in a year (from October to March – 92 mm, from April to October – 96 mm), within a year precipitations are distributed rather proportionally (12-15 mm a month) with a small maximum in the spring and in the fall (18-20 mm). The driest months are June-August (the humidity is about 40% on average), and the wettest are November-January (about 80%). The cloudiest days on cloud base happen in December and January (9 days a month), and clear on total cloud cover are in July-September (about 7-9 days a month). Average annual speed of wind is quite essential - about 4,5 m/s, in the summer – about 4 m/s, in the winter – about 5 m/s. An average number of foggy days are 40 days in a year, with blizzard – 15, with thunderstorm – 19, with hail – 0,5.

Summer in the considered area (from the beginning of May to the middle of September) are mainly sunny, hot and dry - air temperature often exceeds 30^0C (more than 60 days for a warm period) and 40^0C (1-2 days in each of summer months), average monthly relative humidity of air doesn't exceed 45%, air field moisture deficiency with aqueous vapour reaches 30 hPa, with a low amount of precipitation (12-17 mm a month on average, intensity is mainly of 1-5 mm).

Winter comes in the middle of November and lasts to the beginning of March and is characterized with cold, sometimes severe weather – the average temperature of winter months is near - $7\text{-}9^0$C; more than 30 days for the cold period air temperature falls below - 20^0C, 3-5 days - below -30^0C, up to 4 days during the winter there is a thaw period (to +5^0C). Snow cover is quite steady (up to 100 days in a year), low (10-15 cm on average).

Autumn is short (from the middle of September to the middle of November) with prevalence of dry and rather warm weather (average monthly air temperature in September is about 17^0C, October – about 8^0C, November – near -$0{,}5^0$C).

In the **spring** (from the beginning of March to the beginning of May) air temperature quickly grows (from -$1{,}5^0$C in March, 10^0C in April to 18^0C in May), the amount of precipitation increases (to 20 mm a month), wind speed amplifies.

Table 1 shows the elements of bioclimatic capacity of the territory of the supposed placement of HR Inder (in 33 modules) where each module has a category assessment of medico-climatic conditions according to their impact on a person (in points).

Table 1 – Bioclimatic capacity of the territory of the supposed placement of the health resort on the coast of lake Inder

Bioclimatic module	Value	Category of medico-climatic conditions	Assessment in points
1	2	3	4
1. Modules of bioclimatic mode			
Duration of potentially favorable period to hold active measures in the fresh air in clothes according to the season (terrainkur, walks, sport games, etc.)	280	Favorable (slightly biotropic)	3,0
Number of days with comfortable heatfeeling (ET is than 17- 21^0 at wind-and sun protection) during air baths at noon	42	Relatively unfavorable (moderately biotropic)	2,0
Number of days with warm heatfeeling (ET is higher than 22- 24^0 at wind-and sun protection) during air baths at noon	66	Relatively unfavorable (moderately biotropic)	2,0
Number of days with hot heatfeeling (ET is higher than 24^0 at wind-and sun protection) during air baths at noon	28	Unfavorably (highly biotropic)	1,0
Average severity degree of winter according to Bodman, points	3,2	Unfavorably (highly biotropic)	1,0
Frequency of weather severity more than 2 points, %	37	Unfavorably (highly biotropic)	1,0
Index of climate continentality according to L. Gorchinsky, unit	146,2	Unfavorably (highly biotropic)	1,0
Number of days in a year with the average daily air temperature above 15^0 (duration of the summer period)	140	Favorable (slightly biotropic	3,0
Number of days in a year with the average daily air temperature above 25^0 (duration of the heat wave)	30	Unfavorably (highly biotropic	1,0
Number of days with precipitation ≥ 5 mm in a year	55	Relatively unfavorable (moderately biotropic)	2,0
Average monthly air temperature in the summer, ^{0}C	26,0	Unfavorably (highly biotropic)	1,0
Average monthly air temperature in the winter, ^{0}C	-9,0	Relatively unfavorable (moderately biotropic)	2,0
Average monthly speed of wind in the summer, m/s	4,5	Relatively unfavorable (moderately biotropic)	2,0
Average monthly speed of wind in the winter, m/s	5,0	Unfavorably (highly biotropic)	1,0
Snow cover depth in the winter	Less than 15	Unfavorably (highly biotropic)	1,0
Daily average with thunderstorm, days	19	Relatively unfavorable (moderately biotropic)	2,0
Number of foggy days	40	Favorable (slightly biotropic)	3,0

Продолжение таблицы 1

1	2	3	4
2. Mode modules of solar radiation			
Number of hours of sunshine in a year	~2500	Favorable (slightly biotropic)	3,0
Number of hours of sunshine in July	~365	Favorable (slightly biotropic)	3,0
Number of hours of sunshine in December	~85	Relatively unfavorable (moderately biotropic)	2,0
Number of sunless days in a year	~50	Relatively unfavorable (moderately biotropic)	2,0
Number of sunless days in June	~2	Favorable (slightly biotropic)	3,0
Number of sunless days in December	~10	Relatively unfavorable (moderately biotropic)	2,0
Danger level of ultraviolet radiation reaching the land surface at noon in July	9-10	Unfavorably (highly biotropic)	1,0
3. Modules of circulatory mode			
Anti-cyclonic type of atmospheric circulation, %	Более 50	Relatively unfavorable (moderately biotropic)	2,0
Degree of wind effect: number of days with a wind speed of 15 m/s and more	30	Unfavorably (highly biotropic)	1,0
Number of days with dust storms	20	Unfavorably (highly biotropic)	1,0
4. Mode modules of air humidity			
Values frequency of relative humidity that is lower than 30%, days per year	110	Unfavorably (highly biotropic)	1,0
Values frequency of relative humidity at noon that is more than 80%, days per year	80	Unfavorably (highly biotropic)	1,0
Monthly mean degree of air saturation at 1pm in July, %	30	Relatively unfavorable (moderately biotropic)	2,0
Monthly mean degree of air saturation at 1pm in January, %	81	Unfavorably (highly biotropic	1,0
Formation degree of sultriness: sultry weather frequency in the summer, %	5	Favorable (slightly biotropic)	3,0
5. Modules of air ionization			
Middle number of oxygen ions of negative (N-), ion/cm^3 (according to an autumn episode)	669	Favorable (slightly biotropic)	3
Coefficient of unipolarity of ions (CUI)	0,49	Favorable (slightly biotropic)	3,0
Integral assessment of K(BCP) = ∑K1+……+ K33 / 33 = 62/33=1,88 point		Relatively unfavorable (moderately biotropic)	1,88

The carried-out analysis has shown that in general the weather mode in the area of the supposed placement of HR Inder is estimated as training (the integrated indicator of bioclimatic potential of K(BCP) makes 1,88 points from 3,0 possible) which corresponds to rather favorable conditions for climatotherapy organization.

It is necessary to refer the increased level of natural aero ionization to number of positive bioclimatic features of this area – 669 ion/cm^3 (maximum 1340 ion/cm^3) with low coefficient of ions unipolarity (0,49) which is substantially connected with the influence of brine lake Inder where one can find discovered salt d eposits of high quality on 110 km^2 of the surface. As the result of the atmosphere circulation there is a separation and transfer of particles of salt aerosol, fine particle fraction (1-5 micron) of which reaches deep divisions of respiratory tract and has multicomponent medical effect of extremely small doses of substance.

The salt aerosol which is present at the ground atmosphere in small doses stimulates protective mechanisms of respiratory tract, it possesses sanogenic, bronchodraining, anti-inflammatory, immuno-supportive action. The salt aerosol has an inhibiting effect on the growth and microorganisms activity which is followed by the process of their loss of pathogenic properties. Natural antimicrobial action

peculiar to sodium chloride doesn't render negative effect on local protection and promotes improvement of biocenosis of respiratory tract.

The light negative air ions in the air medical environment which are present at the ground atmosphere intensify metabolism and local protection of biological tissues, favorably affect cardiovascular, endocrine systems, digestive tract, mucous membranes of respiratory system, cause adaptogenic action on central and peripheral stress-limiting systems of an organism.

The influence of negative aeroions affects a series of functions of certain organs (vegetative – organic, gas, mineral, water exchange, angenesis, activity of endocrine glands, respiration rhythm and cordial beats, blood structure etc and animal – excitability of nervous and muscular tissues), vital activity of all the organism in general (body height, sexual function, motility, reflexes) and implications of the highest nervous and mental activity [4].

The aero ionic mode is very variable, it depends on the season, an hour, meteorological and anthropogenic factors. In environmentally friendly resort areas the average concentration of the negative ions is 400-700 ion/cm^3. However, in case of the increased aerosol air pollution, high or very low air humidity the level of the negative aero ionization of the air sharply decreases, sometimes to extremal values (lower than 100-200 ion/cm^3). At favorable bioclimatic conditions and low level of aerosol impurity in the ground atmosphere the level of negative aero ions can reach 1200-2500 ion/ cm^3 [14].

Route aero ionization and microclimatic observations in the considered territory and the adjacent area were carried out on 6 platforms with various landscape conditions (table 2) – on the plateau of Indersky mountains where it is supposed to build HR Inder (observation point 1), on the bank of lake Inder (observation point 2), on the tops of the nearest open pits of borat production (observation points 3 and 5) and in their bottom next to picturesque lakes (observation points 4 and 6).

According to route researches in the area of lake Inder the concentration of light negative aero ions (N–) was higher than the level of physiological norm [13], and positive (N+) – below; KUI was in normal limits. In territorial distribution – maximum value (N–) are noted on the plateau 726 an ion/m^3 and on the

Table 2 – Natural ionization of air and microclimatic characteristics in the area of the supposed building of health resort near lake Inder

Observation points	Ionization level, ion/cm^3		CUI (N+/N–), (point)	t, ^{0}C	f, %	v, m/s
	N– (point)	N+				
1. In the area of the headstream Tuzdybulak, ~ -200 m from Lake Inder, the plateau on the NW from the lake	726 (3)	336	0,46 (3)	15,6	32	1,7-2,2
2 The bank of lake Inder, NW sector of the lake, in the area of the headstream Tolepbulak (~ 20 m from the lake face and ~ 10 m from the rock), a crust of silt mud	678 (3)	317	0,47 (3)	8,0	54	2,3-6,7
3. Near pit 99/2, the territory of the Inder mountains and pit barrows, ~ 700 m to the NNW from lake Inder	652 (3)	386	0,59 (3)	6,9	58	1,5-12,2
4. At the bottom of pit 99/2, the width is ~ 200 m, the length is ~ 400 m, near the pit lake	640 (3)	355	0,54 (3)	13,0	34	0,8-1,9
5. Near pit 98, the territory of the Inder mountains and pit barrows, ~ 1 km to the NNW from lake Inder	661 (3)	322	0,49 (3)	7,3	55	0,8-1,9
6. At the bottom of pit 98, the width is ~ 200 m, the length is ~ 400 m, near the pit lake	628 (3)	265	0,42 (3)	9,0	59	2,3-4,5
Average number	664 (3)	330	0,50 (3)			
Maximum value	1340	1090	0,59	15,6	59	12,2
Minimum value	120	120	0,42	6,9	34	0,8
Minimum allowed regulations [19]	600	400	0,4-1,0			
Интегральный модуль по уровню природной ионизации воздуха Integrated module according to the level of natural air ionization [∑(N–)+∑CUI] /n	∑(N–)/n = = 3 points		∑КУИ/n = = 3 points	Integral module [∑(N–)+∑CUI] /2 = 3 points		

Note. N+ and N– are respectively concentration of light positive and negative aero ions (ion/cm^3); KUI is the coefficient of unipolarity of ions (a ratio of concentration of positive and negative ions); t is the air temperature (^{0}C); f is relative humidity of air (%); v is wind speed (m/s); n is the quantity of series of observations.

bank of Lake Inder (N- 678 ion/m^3); the smallest, respectively, in the bottom of pits 98 and 99/2 (N– 628, 640 ion/m^3). KUI on all the sites corresponded to low aerosol air pollution (lower than 1,0) – respectively 0,42-0,59. The integrated module according to balneological scale reached maximum possible values – 3,0 points.

Complex assessment of resort and recreational capacity of the territory of the supposed building of HR Inder for medical and improving use makes 2,25 points from 3 possible (it was calculated proceeding from indicators of modular components: landscape - 1,88 point, bioclimate - 1,88 point, microclimate - 3,0 points and ecological state 2,25 points) which corresponds to the high rehabilitation potential and broad resort and recreational opportunities for the organization of special forms of climatic and landscape therapy in this territory.

The modern natural landscape doesn't perform any "Social and economic functions" and belongs to the category "not in use nowadays" [3]. Its features meet the requirements imposed in the design of constructions with climatic treatment (summer and winter aerosolaria), organization of platforms for landscape treatment, tracking terrenkur (on condition of construction of the park with wood and shrubby vegetation that occupies not less than 40-60% of the planned territory of HR Inder).

The ground atmosphere in the area of the supposed construction of HR Inder is characterized by the increased maintenance of negative aero ions (to 1340 ion/cm^3), at low (favorable) coefficient of unipolarity of ions (KUI = 0,42-0,59). Microclimatic distinctions on platforms of the territory, different in landscape, were insignificant, weather conditions were close to climatic norm for this period of the year. The integrated module of natural air ionization made 3,0 points (very high).

Solar radiation sufficiency is estimated as rather favorable (365 hours in July; 30 hours in January). During the whole year the solar range has biologically active ultra-violet solar radiation (with the wavelength of 290-315 nanometers). According to these indicators the territory of HR Inder is among rather favorable for the organization of year-round (except for the periods of strong cold and heat) heliotherapy (integrated rehabilitation potential of solar radiation reaches 2,28 points from 3,0 possible).

Atmospheric circulation to which variability meteosensitive patients especially react in this territory is for the whole year estimated by irritating influence mode (circulating potential is 1,33 points from 3 possible) which indicates the appicability of the planned meteoprophylaxis. The construction of the park with wood vegetation will promote the correction of wind mode and the improvement of microclimate in this territory.

The ecological state in the area of the supposed construction of HR Inder corresponds to features of its arrangement far from large industrial centers. The integrated indicator of air pollution is equal 2,25 points which is estimated as a low level of anthropogenic influence. The sanitary condition of the territory has to be monitored constantly and be supported by a complex of relevant activities for its improvement.

Table 3 – Perspective types of year-round climatic and landscape treatment in the territory of the supposed construction of HR Inder

Kinds of climatic and landscape treatment	Requirements to the organization of climatic and landscape treatment
Air baths at rest and in combination with physical exercises, aero chromotherapy (all the year round)	Summer and winter aerosolaria (or specially equipped climatic chambers, climatic platforms) with corrective microclimate devices, medical and bioclimatic control
General or local insolation, baths of the light solar radiation (during the warm period of year)	
Day and night sleeping in the open air (all the year round)	
Long-term rest in the fresh air in clothes according to the season (all the year round)	The equipped recreational platforms (in the summer - in a shadow of trees, in the winter – on the sunny side)
Trainings with measured (healthy) walking on terrainkur (all the year round)	The equipped avenues of terrainkur with breakdown by stations (through each 100 m) equipped with benches and arbors for rest. It is possible to use the former pits with terraced slopes and picturesque lakes at the bottom for these purposes
Aeroionophytotherapy (during the warm period of year)	Platforms with certain vegetable associations

The listed above indicators of the condition of environments correspond to resort areas with favorable gentle training mode of climate exposure, landscape and ecological state on a human body and testify to the raised potential opportunities for the organization of various forms of climatic-landscape therapy all the year round: aero therapies and heliotherapies both in the open air and in specially equipped aerosolaria; natural aeroionophytotherapy in the summer; physical trainings with walking including "Scandinavian", on health paths; nearby tourism (table 3).

Conclusion. The complex research of resort and recreational capacity of the territory of the supposed construction of resort Inder for health improving use has revealed a high rehabilitation potential (2,25 points from 3,0 possible) and broad resort and recreational opportunities for the organization of special forms of climatic treatment in this territory. The bioclimate of the territory creates rather favorable background for other resort methods of treatment. There have been found specific favorable bioclimatic features of the given area: high purity of the ground atmosphere, existence of biologically active ultraviolet solar radiation (with the wavelength of 290-315 nanometers) within a year, existence of small doses of finely-divided chlorhydric aerosol in the ground atmosphere, the increased level of natural aero ionization (to 1340 an ion/cm^3) with low coefficient of unipolarity of the ions (lower than 1,0) characterizing the ground atmosphere of the coast of lake Inder as clean with high medical and improving functions, the long period with favorable weather conditions to stay in the fresh air (280 days in a year). Bioclimatic conditions are favorable for the organization of year-round aero - and heliotherapies, natural aero ionization, terrainkur and recreational activities in the open air on condition that 60% of the gardening of the territory and the construction of a year-round climatic medical centre.

The organization of a health resort complex on the coast of lake Inder (the Republic of Kazakhstan) corresponds to the State programme of development of health care of the Republic of Kazakhstan "Densaulyk" for 2016–2019, its purpose is to strengthen health of the population for ensuring sustainable social and economic development of the country [15].

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ҚАЗАҚСТАН РЕСПУБЛИКАСЫ ИНДЕР КӨЛІ ЖАҒАЛАУЫНЫҢ КЛИМАТПЕН ЕМДЕУДІҢ БИОКЛИМАТТЫҚ ЖАҒДАЙЫ

Аннотация. Мақалада Қазақстан Республикасы Индер көлі жағалауының биоклиматтық ерекшеліктеріне жүргізілген ізденістердің нәтижелері келтірілген, осының негізінде аймақтың биоклиматтық потенциалы (3,0 мүмкіндіктен 2,25 балл) бағаланған және жыл бойына климаттық емдеу мекемесін тұрғызып, оның 60% аймағын көгалдандырған жағдайдакурорттық климатпен емдеу мақсатындағы сәйкестік категориясы - өте жоғары. Осы жердің биоклиматтық ерекшелігінің өзіндік қолайлылығы (жербеті атмосферасының тазалығының жоғарлылығы, жыл бойына күн радиацының (толқын ұзындығы 290-315 нм) биологиялық активті ультракүлгін сәулесінің бар екендігі, жербеті атмосферасында ұсақдисперциялық тұз аэрозолдарының дозасыныңаз деңгейде кездесіп, табиғи аэроиондардың деңгейінің жоғарлығы (1340 ион/см^3 дейін) иондардың бір полюстілігі (униполярлығы) коэффициентінің төмен (1,0 төмен), қолайлы жағдайдағы таза ауада болу мерзімінің ұзақтығы (жылына 280 күн)) анықталды.Биоклиматтық жағдайы жыл бойына аэро- және күн тераппиясын, табиғи аэроиондық терренкур және ашық ауада рекрациялық іс-шаралар ұйымдастыруға қолайлы.

Тірек сөздер: Қазақстан республикасы Индер көлі жағалауының биоклиматтық потенциалы, табиғи аэроиондау, курорттықклиматпен емдеуді ұйымдастырудың болашағы.

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БИОКЛИМАТИЧЕСКИЕ УСЛОВИЯ КЛИМАТОЛЕЧЕНИЯ НА ПОБЕРЕЖЬЕ ОЗЕРА ИНДЕР РЕСПУБЛИКИ КАЗАХСТАН

Аннотация. В статье приводятся результаты исследования биоклиматических особенностей на побережье озера Индер (Республика Казахстан), на основе которых оценен биоклиматический потенциал данной территории (2,25 балла из 3,0 возможных), и категория ее соответствия для целей курортного климато-

лечения – высокая при условии 60% озеленения территории и строительства круглогодичной климатолечебницы. Выявлены специфические благоприятные биоклиматические особенности данной местности (высокая чистота приземной атмосферы, наличие биологически активной ультрафиолетовой солнечной радиации (с длиной волны 290-315 нм) в течение круглого года, наличие в приземной атмосфере малых доз мелкодисперсного соляного аэрозоля, повышенный уровень природной аэроионизации (до 1340 ион/см^3) с низким коэффициентом униполярности ионов (ниже 1,0), продолжительный период с благоприятными условиями для пребывания на свежем воздухе (280 дней в году). Биоклиматические условия благоприятны для организации круглогодичной аэро- и гелиотерапии, природной аэроионизации, терренкура и рекреационных мероприятий на открытом воздухе.

Ключевые слова: биоклиматический потенциал побережья озера Индер Республики Казахстан, природная аэроионизация, перспективы организации курортного климатолечения.

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