

Vision of the Cross-Border Zeolitic Tuff Cluster

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Abstract

The natural consequence of observed changes and trends in the macroeconomic scale include formation of the clusters. Nowadays, clustering is an increasingly more popular form of business organization, and it is becoming more significant from year to year. In Poland, clusters are relatively new forms of self-organization business, which are supported by the administrative authorities, and is based on mutual cooperation between entrepreneurs or producers and development research units on a specific area. The aim of the project carried out by University of Management and Administration in Zamość entitled "Description of an innovative model of cross-border application of zeolitic tuffs" was establishment of a functioning institutionalized cooperation networks in the form of a cross-border zeolitic tuff cluster on a Polish-Ukrainian cross-border area. The objective of this article is to present mission and vision of the Cross-border Zeolitic Tuff Cluster. Mainly, the authors focus on a various possibilities of application of zeolitic tuffs and main areas of functioning of the cluster. On this basis, authors described strengths, weaknesses, opportunities and threats of functioning of the Cross-border Zeolitic Tuff Cluster and proposed the development trends of cluster.

Keywords: clusters, the cluster initiative, the Cross-border Zeolitic Tuff Cluster

Introduction

Nowadays, it is becoming more common the idea of clusters. This is a new direction of thinking about creating competitiveness and innovation in companies. First of all, clusters provide the stimulation of economic development of regions, technological development, innovation and employment growth as well. According to this, the main reason for the development of clusters is the economic foundation. Clusters creates opportunities for achieving higher productivity of companies, which explains, among others, the Williamson's concept of transaction costs (Williamson 1998) and application of the concept of flexible specialization (Becattini 1991; Brusco 1982).

The right definition for a cluster in economic theory is confirmed in legal terms recognized in paragraph 13 point 2 regulation of the Minister of Economy of December 2, 2006 regarding to provide by the Polish Agency for Enterprise Development financial aid not related to operational programs.¹ The legislator provides following definition: „the cluster is understood as a spatial and sectoral concentration of units for economic or innovation development and at least ten entrepreneurs should be engaged in business activity in one or several neighboring voivodships, competing and cooperating in the same or related industries and associated extended formal or informal network, at least half of entities operating within the cluster are entrepreneurs”.

According to the above definition, it can be concluded that cluster is understood as a group of related companies, institutions and other types of organizations that are focused on activity in the same area. Therefore, clusters are a form of specific links included in structure of all its units. First of all, they combine cooperation with competition. These complex and unique relationships referred to definition of cooptition (Cygler 2009; Dagnino et al. 2008) should be understood as a kind of

1. See: Rozporządzenie Ministra Gospodarki z dnia 2 grudnia 2006 r. w sprawie udzielania przez Polską Agencję Rozwoju Przedsiębiorczości pomocy finansowej niezwiązanej z programami operacyjnymi. DzU z 2006 r. nr 226 poz. 1651.

strategy for creating value and competition as well in the distribution of value in conditions of only a partial convergence of objectives and the changing structure of the positive-sum game. Therefore, definition of coopetition justify, that the competitive advantage is determined through skill of common application of resources held by all entities functioning in specific industries.

According to this, cluster formula is ideal solution for use growth potential entities using in their business zeolitic tuffs, build stable foundations for their activities and growth, as well as creating conditions for strengthening their competitiveness in the micro and macro environment.

1 General characteristics of the cluster initiative — its mission, vision, organizational structure and model of functioning

The objective of a cluster is usually formulated in such a way so as its implementation contributed to the fulfillment of the cluster's mission and vision. The mission of the Cross-border Zeolitic Tuff Cluster concentrates on assisting the development of the companies which are members of the cluster, and as a result it is to contribute to the development of the whole region. The mission of the cluster should acknowledge such elements as:

- a balanced and stable development of the region and the development of the members of the cluster
- acknowledgement of the preferences of the customers both on the external and internal market
- implementation of innovating technologies and ecological solutions

The vision of the Cross-border Zeolitic Tuff Cluster is an appropriately organized and well-functioning cluster economic network, which conducts its activity for the commonly defined objectives of the member companies, entrepreneurs and the social and economic environment. The vision of the cluster should acknowledge among other things:

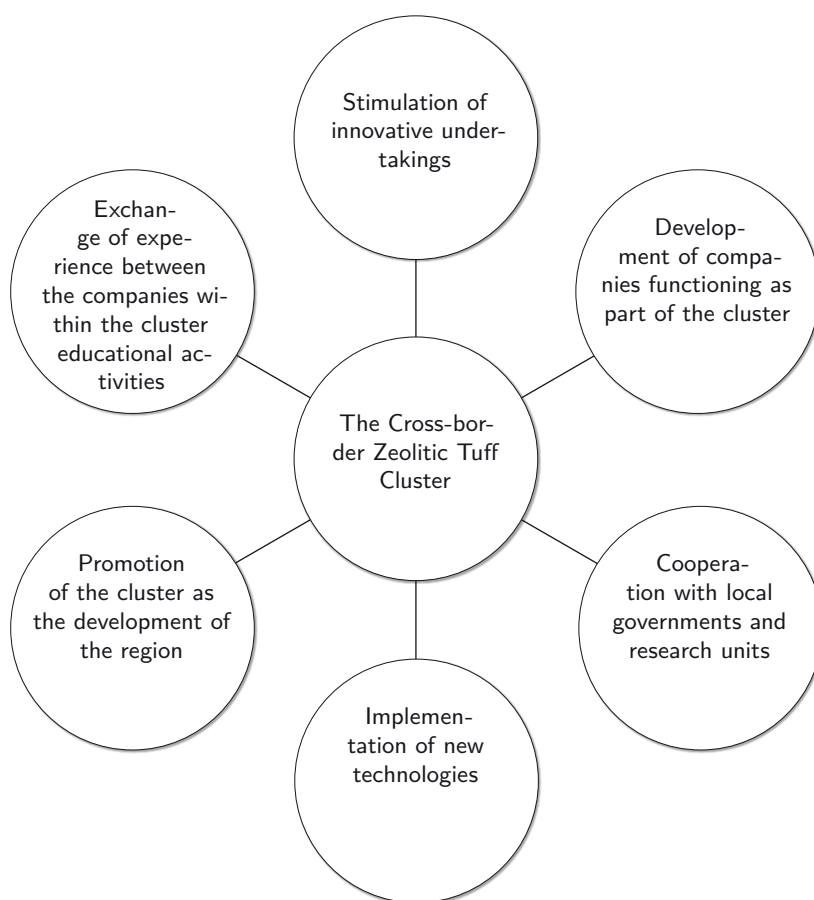


Fig. 1. Factors which influence the mission and vision of the cluster

- gaining a competitive advantage thanks to high-quality products
- cooperation between all the members of the cluster with regard to all aspects of the economic activity
- a desired future state of the economic network, which will contribute to the implementation of the assumed goals
- the scope and objectives of cooperation between research institutions

It is worth to stressed that actions aiming at the region development are an important element of the process of creating the vision and mission of the cluster. Moreover, special attention is paid to the cooperation between the entities which are cluster members and their development. All the factors enumerated in figure 1 have influence on the mission and vision of the cluster.

2 An exemplary suggested vision of the Cross-border Zeolitic Tuff Cluster

The Cross-border Zeolitic Tuff Cluster is an initiative which is well-recognized at home and abroad, which has the knowledge regarding the possibility of using zeolitic tuffs and works on the directions of development of the region in this field, and which is the source of initiatives supporting innovativeness and cooperation between the economic, research, academic and local government environments.

2.1 An exemplary suggested mission of the Cross-border Zeolitic Tuff Cluster

The mission of the Cross-border Zeolitic Tuff Cluster comprises constant striving to discover new possible applications of zeolitic tuffs by conducting research, promoting the potential of the Cluster among investors at home and abroad, and also supporting the integration of the Cluster members with academic, business and local government partners from the Lubelskie Voivodship regarding common actions to increase the competitiveness of the region and creating a platform of cooperation for entrepreneurs, research institutions, public administration institutions and business support organizations to promote the possibilities of use of zeolite tuffs in shaping the future development of the agriculture and construction sectors of the Lubelskie Voivodship.

To determine the organizational structure of the cluster, a solution presented in the manual “Jak stworzyć klaster,”² can be suggested, which comprises three spheres (Szajna and Kamycki 2011):

- The primary sphere, which is the essence of the cluster, and within which the following units function:
 - an agreement between enterprises and other cluster members on cooperation, expressed as a contract of cluster formation, and
 - the council of the cluster (composed of persons representing cluster members)
- The sphere coordinating and managing the activity of the cluster, in which the following units function:
 - a cluster association (or some other legal business activity), and
 - the board, which carries out organizational tasks and implements other regulations of the council of the cluster
- The sphere of common tasks and undertakings which are implemented by the so called cluster initiatives, for example common promotional actions, etc.

Functioning of the cluster, and in particular its management should be based on the organizational structure which is quite simple and does not constitute any organizational or formal and legal problems, whose goals are clearly defined and competences specified. A suggested functional and organizational scheme which can constitute a model for the Cross-border Zeolite Tuff Cluster is presented in figure 2. The said model assumes a possible participation in the management of the current activity of the cluster of some other legal entity, that is a “cluster” association appointed by the representatives of the members of the cluster. The entity fulfilling the management function can be a business support institution, a company which is part of the cluster, or some other association. It is very important for the entity to be a legal person because its tasks will be connected with executing contracts or conducting selected activities of the cluster.

2. [How to form a cluster].

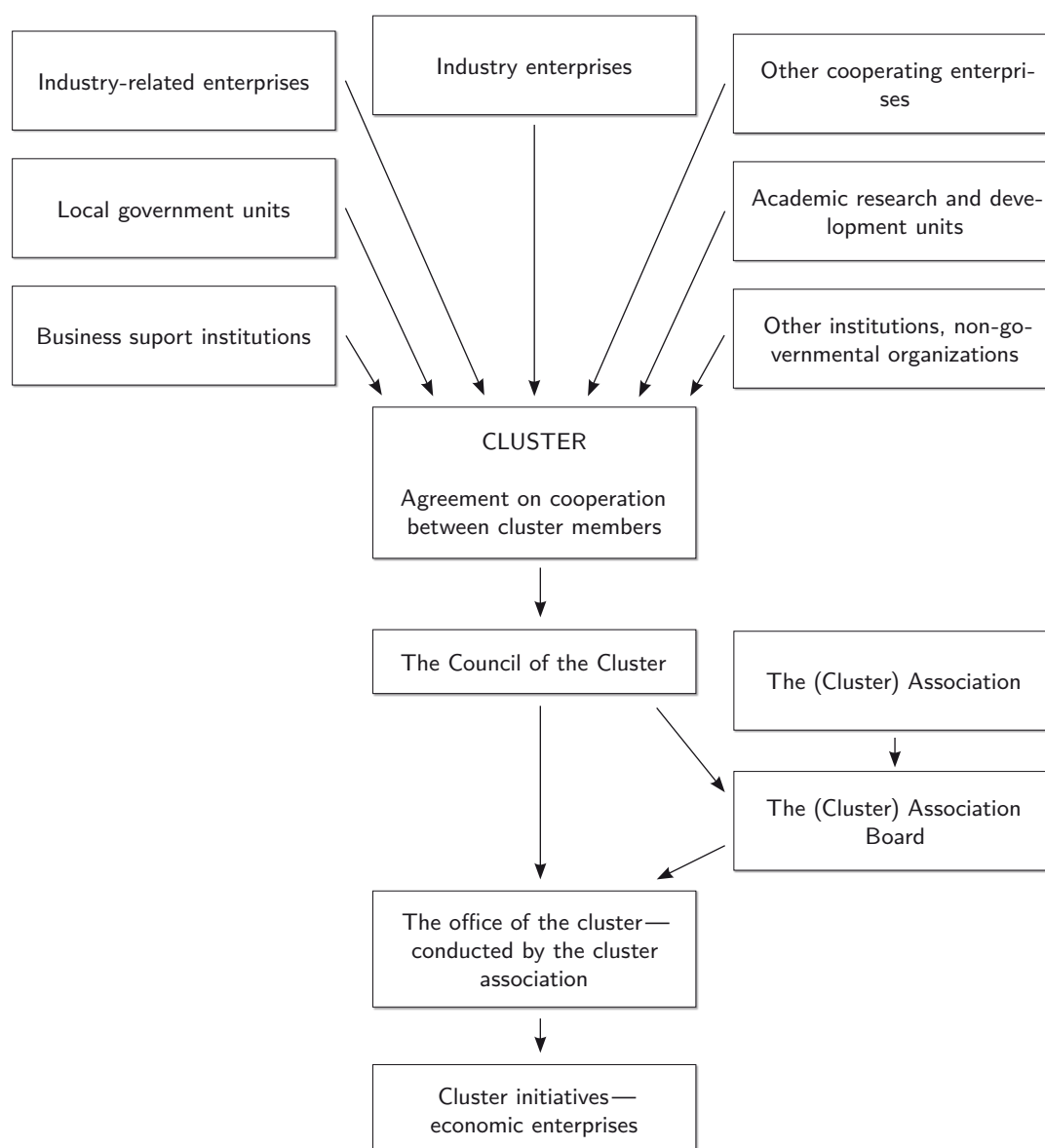


Fig. 2. A functional and organizational scheme of the cluster (with the association as a coordinator)

The model presented above assumes that a cluster is an organization which is not a legal person and which has been formed as a result of a “cooperation agreement” between legally equivalent entities. In this situation usually a legal managing entity is appointed which represents the cluster on the outside. The selection of this legal form of the managing entity of the cluster is caused by simple procedures, easiness of setting up an association and the possibility to be exempt from income tax on resources for statutory activity. It must also be noted that both the cluster and the association have the same “source” of formation and where the cluster is composed of for example enterprises, and the association comprises representatives of the enterprises; they are usually company owners or managers.

2.2 Possible applications of zeolitic tuffs

Zeolites are aluminosilicates: Ca, Na, Ba, Sr, K, Mn and Mg. Their characteristic feature is their structure built of $(\text{SiO}_4)^{4-}$ i $(\text{AlO}_4)^{5-}$ tetrahedra linked to each other in such a way that there are cavities and channels inside, where the molecules of H_2O and monovalent and double-valent cations may reside (Bałys and Buczek 2007, 12). Zeolites are divided into two basic groups, and this division results from different processes which condition the formation of zeolites. The first group comprises zeolites which fill the cavities or vesicles of rocks. The second group is rock-forming zeolites

(Cicisvili et al. 1990). It should be underlined that deposits of zeolites of the first type (vesicle deposits) comprise all the currently known naturally occurring zeolites. Their deposits in cross-section are from 1 millimeter to several dozen millimeters in size. What is important, these deposits usually consist of many minerals, and in a single sample from four to five types of zeolites can be identified. Minerals which usually accompany zeolites are: fluorites, sulphide minerals, chlorites, epidotes, prehnites, opal, apophyllites, chalcedony, quartz, calcite, etc. (Cicisvili et al. 1990, 12).

Zeolitic tuffs are intermediate rocks between magmatic rocks and sedimentary rocks. The initial material from which zeolites are formed is the product of volcanic activity, and the very process of formation of zeolites is a typical one and is similar to the process of sedimentary rocks formation. Table 1 presented below shows types of rock-forming zeolite deposits (second type enumerated above); the classification acknowledges the thermal conditions and the type of pore water.

The classification of zeolites presented in table 1 proves that they constitute a very extensive and internally diversified group of minerals. The range of potential applications of zeolitic tuffs in economy is as extensive as the classification presented above. Quoting the data published in *Minerals Yearbook of 2013* it must be pointed out that the worldwide production of natural

Tab. 1. Types of rock-forming zeolite deposits

| Zeolitegroup | Types of zeolites distinguished within the group | |
|--|---|---|
| Group No. 1 Zeolites formed in raised temperature conditions | Primary magmatic zeolites | The only zeolite which is formed in the final stage of the process of magma crystallisation is analcime |
| | Zeolites formed in the process of contact metamorphism | Zeolite deposits of this type are formed in the areas of contact between volcanic complexes which intrude into the layers of volcanic ashes and pyroclastic rocks |
| | Zeolites formed in the process of hydro-thermal metamorphism | These zeolites are formed as a result of the reaction between rocks and alkaline groundwaters and weak-acid waters |
| | Zeolites formed in the process of very low-degree diagenesis and metamorphism | These zeolite deposits are formed as a result of salt or freshwater penetrating the sedimentary layers |
| Group No. 2 Zeolites formed at the ground surfaces of the lithosphere | Zeolites formed in the groundwater percolation zone | Zeolites are formed as a result of atmospheric water percolating into the lithosphere onto loose pyroclastic rocks |
| | Zeolites situated in the weathering zone | Zeolites are formed in the process of weathering from appropriate materials of the lithosphere at high pH (in this way phillipsite and analcime are formed) |
| | Zeolites formed in the alkaline water and lake deposit zone | Deposits of this type can be found in desert and semi-desert regions and they comprise zeolites such as phillipsite, mordenite, erionite and chabazite |
| Group No. 3 Zeolites formed in low temperatures | Zeolites localised in the bottom deposit zone of contemporary ocean waters | Potassium zeolite can be found there such as phillipsite and clinoptilolite Other types of zeolites localised in the bottom deposits of contemporary ocean waters are found very rarely |
| Group No. 4 Impact crater zeolites | Zeolites localised in the region of impact craters | Zeolites of this type are formed as a result of impact metamorphism Zeolites in impact craters are formed in the same conditions as in the other classes, that is in the processes of for example weathering and diagenesis |

Source: Coombs and others (1997), Clifton (1987), and Deer and Howie (2004)

zeolites in 2012 ranged from 2,7 to 3,2 million tons.³ China remains the international leader in the production of natural tuffs (including zeolitic tuffs) with a result between 1,8 and 2,2 million tons.⁴ The second place with a result of 230 000 tons holds the Republic of Korea. The following places are held by Turkey (150 000 tons), the United States of America (74 000 tons), Cuba (45 000 tons), Jordan (15 000 tons), Mexico (2 100 tons) and Indonesia (1 600 tons).⁵ Such a great scale of zeolite production is caused by many possible applications of tuffs in many fields of life and in many spheres of the economy. They can be used for example in medicine, environment protection, in the chemical industry, microelectronics, building and agriculture. The main elements included in tuffs such as potassic and soda feldspars, layer aluminosilicates and mica have many more applications.

Zeolitic tuffs are used in medicine for the following: the regulation of the level of micro elements in the human body and removing of many toxic substances from the body, such as pesticides, fungicides, herbicides, heavy metals and others. Zeolites are also used in diagnostics and treatment of many cancerous diseases, in treating gastric disorders, liver disorders, hemodialysis⁶ and hemoperfusion⁷, and also in the treatment of osteoporosis and diabetes. Potassic feldspars which are present in tuffs are used in dentistry for the production of false teeth (see: Chatterjee 2009). Currently research is conducted regarding the possibility of using tuffs for the treatment of Attention Deficit Hyperactivity Disorder (ADHD). Zeolitic tuffs are also used in medicine as contrast material in magnetic resonance and as an anticancer and vaccine adjuvant. Aluminosilicates are also carriers of radionuclides in targeted therapy and moreover they are used as a biosensor, detoxicant, disinfectant and antibacterial agent.

Zeolitic tuffs are also used in the cosmetic industry. Body scrubs with volcanic rocks are available on the market. Cosmetics with volcanic minerals (due to their composition and ion exchange properties) provide numerous macro and microelements (including potassium, iron, calcium, sodium and magnesium) necessary for the appropriate functioning of the skin. Thanks to their properties, volcanic aluminosilicates are used in the beauty industry (not only for the treatment of oily and acne skin). They can also be found in such products as creams, tonics, masks, liquids, shower gels and shampoos. Thanks to their porous structure, tuffs (and also the structure of volcanic dust and clay) can effectively absorb the bacteria and toxins from the surface of the skin. What is more, the characteristic unevenness of tuffs contributes to the effect of micro-massage, cleaning the skin pores. Volcanic clays act as antiseptics and antibiotics, helping to treat cellulite (Mikuła and Łach 2012, 114–115).

Zeolitic tuffs are widely used in environment protection and engineering, and their possible applications include the removal of ammonia nitrogen, nitrates and phosphates from water solutions and elimination of petroleum-related compounds and heavy metals from industrial waste. A detailed analysis of their possible applications shows that zeolites and zeolitic tuffs can be used in the production of air-conditioning units. On the other hand, in the field of renewable energy they play the role of heat exchangers, because they consume tetraethyl lead ($(C_2H_5)_4Pb$), a poisonous compound, which is present in combustion gases. Thanks to their micro-porous structure, clinoptilolite and mordenite are used to remove SO_2 from the gases and fumes from factory chimneys and chabazite is used to remove CO_2 and H_2S from natural gas. Moreover, thanks to their high acid resistance, high-silica natural zeolites are used to consume such gases as nitric oxides or nitrosyl chloride. During the separation of two-element mixture $O_2 - N_2$, zeolites display high adsorption selectivity in relation to molecular nitrogen, and by that they enrich air with oxygen. Zeolites can also be used for the absorption of metal oxides from gaseous industrial waste. For example mordenite

3. The presented data ranges, because the estimates are based on production claimed by countries, some of the amounts are based on market trends, and other calculations are based on production estimates as published in trade journals, Virta 2013.

4. [In the journal European practice of number notation is followed—for example, 36 333,33 (European style) = 36 333.33 (Canadian style) = 36,333.33 (US and British style).—Ed.]

5. The figures are based on Virta (2013).

6. Hemodialysis is a medical procedure used to achieve removal of waste products and free water from the blood, (author's note).

7. Hemoperfusion is a procedure in which the patient's blood is pumped through a device outside the patient's body to be filtered thanks to absorptive substances, (author's note).

and clinoptilolite can be used for the removal of rhenium. What is more zeolites are used to purify mine water of increased ^{226}Ra and ^{228}Ra , and in the production of shale gas, zeolites are used to remove heavy metal ions from waste. Tuffs are also used to consume tetraethyl lead expelled from combustion engines, and to dry and purify technological gases and liquids to improve the quality of raw materials and final products. Finally, ion exchange properties of zeolites and zeolitic tuffs make it possible for them to be used for the removal of ammonium ions and water softening.

Zeolites and zeolitic tuffs are also used in the construction industry. Tuffs are used as stable elements for the production of pozzolan cement and masonry mortar containing trass (volcanic tuff).⁸ These kinds of mortar, thanks to silica included in tuff, have hydraulic properties and are resistant to calcium lixiviation. A potential application of zeolites also comprises the production of renovation plaster for damp walls and saline surfaces. Tuffs are also used for the production of concrete, setts, concrete constructions and cellular and reinforced concrete. They also constitute one of the composites of filling materials. Aluminosilicates such as tuffs can also be used for the production of ceramic pigments. Tuffs are also used for the production of roof tiles, balcony plates and facade boards.

Research into the influence of tuff addition on the anticorrosive properties of steel has shown that tuff eliminates subsurface corrosion, increases adhesion and impact resistance and increases resistance to abrasion (Hebdowska 2010). Thanks to their extensive surface, sorptive properties and resistance to abrasion, tuff particles can be used as a ceramic component in paints and varnishes (Umiński et al. 2005). Natural zeolites may also constitute an effective universal mineral sorbing agent and a sorbent of petroleum-related substances. They can also be used as additives modifying the properties of the raw mix for the production of ceramsite. Zeolites are also used for the production of asphalt and mineral mixes with a lowered temperature of mixing (Judycki and Stienss 2011). To sum up, the use of zeolites and zeolitic tuffs in construction brings many advantages comprising:

- increased concrete strength,
- increased resistance to frost and other climate conditions,
- increased resistance to bending and compressing,
- increased resistance to sulphates,
- improved stabilizing properties,
- financial saving,
- decreased absorbability (Gołek 2007).

Zeolites can also be used for the processing of plastics. The studies of thermoplastic composites using tuffs have shown that such composites are characterised by better stiffness and hardness of the surface (Žmudka et al. 2009). The use of tuffs increases the resistance to temperature and restricts shrinkage. Due to their high flow rate, tuffs can be used for the injection moulding of products with more complex shapes, and can additionally constitute a substitute of more expensive admixtures, such as pigments or agents decreasing combustibility. Composites filled with tuff can be used for the production of electrotechnical elements (including lighting elements) and frictional materials. The use of aluminosilicates improves resistance properties, technical elasticity and resistance, resistance to organic solvents and improves fire extinguishing.⁹ Research has proven the possibility of using ground zeolitic tuff (first submitted to thermal and chemical processing) as an effective and environment-friendly compatibilizer of high-density polyethylene recycles mixes.¹⁰ Tuff composites are characterised by a high temperature of softening, which is important for using the material in electrodes for resistance welding. Tuff is cheap and available and the process of producing electrodes with tuff is simple and relatively inexpensive. Tuffs can also be used in metal composites as reinforcement saturated by a liquid metal matrix (Nagolska 2008, 409–413). Another interesting example of zeolitic tuff application is geopolymers (i.e., inorganic polymers), which

8. Due to constantly increasing prices of energy and environment pollution, bonding agents other than Portland cement are being sought. It is estimated that six times less carbon dioxide is produced during the production of geopolymers than during the production of cement (see: Mikula and Lach 2012, 119).

9. More information can be found in (Kurzydłowski and Lewandowska 2010).

10. More information can be found in (Kuciel, Kuźniar, and Mikula 2011).

are aluminosilicate materials which have excellent physical and chemical properties and a wide range of potential applications. They can be used in such industries as construction (for example for repairing airport aprons), motorization (for example for the production of exhaust pipes in boilers F1) and even aviation (geopolymers are used for the production of heat shields in space shuttles) (Gołek 2007).

Tuffs are also commonly used in agriculture. They are used as additives in fertilizers and feeds, soil conditioners¹¹ pesticide and herbicide carriers and nutrients for plants. Zeolites are also used to prevent the eutrophication of fish ponds and pond aeration with oxygen obtained from air separation. Such a great diversification of the application of zeolites and zeolitic tuffs is possible mainly to their ability to prevent the process of rinsing out nutrients from soil. Fertilisers can be active longer. Tuffs store water, improve soil air and water control, and finally facilitate plant rooting. Another characteristic feature of zeolites, which enables their application in agriculture, is their possibility to conduct ion exchange, which means selective absorption by zeolites harmful and unwanted elements from soil, water or air.¹² Tuffs can also be used for the production of fertilisers. Zeolites improve the effectiveness of the process of soil fertilisation. They regulate the processes of capturing nutrients and their release into soil (potassium, ammonium and phosphorus ions), lower alkalinity and stimulate microbiological activity, help to reach and preserve alkaline balance and positively influence soil pH. It is mainly due to these features that particular attention is drawn nowadays to the so called intelligent fertilisers.

The use of zeolites in agriculture means better rooting for plants, stimulates the processes of grass and grain sprouting and growing, and thanks to their properties they contribute to the absorption of toxic substances. Compost and soil activators are created on the basis of volcanic rocks. Products based on zeolitic tuffs are used to prepare the bedding in stables, piggeries and cow sheds, both to stop decay processes and to avoid the oppressive stench, and also to speed up the process of composting and mineralisation of stubble, harvest wastes and green fertilisers. Volcanic tuffs in agriculture also increase air in soil and facilitate water drainage, and volcanic sand and gravel may be used as animal litter in litter boxes. Thanks to their sorptive properties, tuffs very effectively absorb moisture and unpleasant smell.

The above presented range of possible applications of zeolites and zeolitic tuffs does not exhaust a possible potential of possibilities resulting from the properties of aluminosilicates of volcanic origin. Every year, the potential scale of possible applications of natural zeolites increases, and the increase corresponds to the rate of discovering new properties of the rocks. Undoubtedly, one of the most interesting features of zeolites is such a wide range of their possible applications, starting from construction, environmental industry and engineering, through agriculture, to medicine. This diversification of the possible applications of zeolites is their additional advantage. It is so, because it enables cost reduction because entities from different industries share the costs necessary for their obtaining and processing. What follows, it means that the structure of a cluster is the most optimal one to make the best use of the potential of the “raw material,” also when we consider the reduction of the costs of its obtaining, initial processing and preparing for further, fully specified, applications.

3 The SWOT analysis of the cluster

A SWOT analysis was developed in the 50s of the twentieth century on the basis of the Force Field Analysis created by Kurt Lewin and it helps to gather data, put them in order and present them clearly. It is one of the most commonly used methods in the analysis of all kinds of economic enterprises. It is often treated as the first step in a strategic analysis. Its wide range of applications results from the fact that this method is a universal and flexible one. Thanks to it simultaneously the context of an organization and its potential can be analyzed, and a strategic plan of the

11. A soil conditioner is a modern product which is used in horticulture. It stores water and lets plants absorb it gradually in necessary amounts.

12. Affinity in relation to heavy metal is also noticeable. It means that colloidal particles may be retained in mesopores of zeolites.

organization may be formulated. Its flexibility is also connected with the fact that this analysis may be used not only for analyzing entities, but it is also effective in the assessment of for example countries, local governments, organizations or their parts and people. It is also used to evaluate the effectiveness of undertakings, plans and projects.

The word SWOT is an acronym of the following words: “Strengths,” “Weaknesses,” “Opportunities,” and “Threats.” Lisiński observes that the SWOT analysis is a concept which combines all the other methods of strategic planning. The SWOT analysis methodology may be brought down to three stages:

1. Analysis of opportunities and threats

Such conditions (phenomena, processes, ventures, trends) should be identified which, when used appropriately, will positively influence the organization, and at the same time will become opportunities. At the same time the unfavorable conditions, that is threats, should be identified. Opportunities and threats are thus external conditions in relation to the entity/enterprise, which usually cannot be much influenced.

2. Analysis of strengths and weaknesses

The strengths and weaknesses of the entity/enterprise are analyzed. Strengths are those factors which when used appropriately may contribute to the success. Weaknesses are those aspects whose impact, if it is not weakened or eliminated, may in the future slow down the development of the enterprise or to weaken the results of the undertaking.

3. Defining the strategic position and choosing the strategy and organization (Lisiński 2004, 224)

The analysis of the opportunities and chances and of the strengths and weaknesses of an entity/enterprise is the starting point in determining the strategic position, analyzing the strategic options and choosing the most appropriate for the needs and conditions of the entity.

In the case of the Cross-border Zeolitic Tuff Cluster, the SWOT analysis was based on the analysis of the available literature and materials regarding the cluster and the project entitled: “Working out an innovative model of the cross-border use of zeolitic tuffs,” experts’ opinions and interviews with the project managers. The table below presents the strengths and weakness and the opportunities and threats.

4 Main areas of activities of the cluster

Agriculture is the traditional field of the economy of the region. Therefore, the Regional Development Strategy of the Lubelskie Voivodship for the years 2014–2020 (with the prospect of 2030) presents strategic objective: Restructuring of agriculture and rural areas (*Strategia rozwoju województwa...* 2014, 41–42). The objective will be implemented by using following operational objectives:

- improving the conditions for growth of competitiveness and marketability of farms
- the development of agro-food processing
- strengthening agricultural advisory and to promote and support cooperation initiatives of farmers and rural residents
- supporting of entrepreneurship in the countryside

Clusters are an innovative structures in modern economy. Increasing innovative trends of business activities in the region in order to implement another strategic objective included in the Regional Development Strategy of the Lubelskie Voivodship for the years 2014–2020 (with the prospect of 2030): selective maximizing the potential of knowledge, skills, technological advancement, entrepreneurship and innovativeness of the region (*Strategia rozwoju województwa...* 2014, 45). On the one hand, this will allow for development of the region, on the other hand it will support expanded research and development facilities.

The common activities in the cluster, associating of various companies and entities from various industries operating in the agricultural and construction sector as well to achieve a common objective. Activities are not limited only to the area of the one region, but also cover other regions and neighbouring countries. Main areas of activities of the Cross-border Zeolitic Tuff are following (Szajna and Kamycki 2011):

Tab. 2. The SWOT analysis of the cluster — strengths and weakness and opportunities and threats

| STRENGTHS | WEAKNESSES |
|--|--|
| <ul style="list-style-type: none"> • a big number of enterprises which want to join the cluster • cooperation with research and development institutions • both economic entities and research institutions are interested in participation in the cluster • the substantive base where the cluster is to be located creates favourable conditions for the diffusion of knowledge • the cluster assumes cross-national cooperation; | <ul style="list-style-type: none"> • weakly developed informal ties between cluster members • lack of financial resources for conducting current activities of the cluster • insufficient communication between cluster members • weak ties between entities from the same industry • huge investments are necessary in order to adjust the existing technologies to the needs of using tuffs • no guaranteed financing of the activity of the cluster after the project is completed • the properties of the tuffs are not fully known, so the possibilities of substituting other materials with tuffs are also not fully known |
| OPPORTUNITIES | THREATS |
| <ul style="list-style-type: none"> • a wide range of possible applications of zeolitic tuffs in different branches of industry • a big number of food producing and processing plants, a big number of potential cluster members • higher education institutions whose profile agrees with the cluster's activity function in the area • local authorities offer support for creating clusters and for their functioning • location - there are three countries in the immediate vicinity: Poland, Belarus and Ukraine • six border crossing points • the most important transcontinental road routes railway lines go across the area of the cluster: from Brussels, Berlin and Warsaw, and to Lviv, Odessa, Kiev, Minsk and Moscow • low cost of work in the region • strong academic centres • subsidies for research and development activity in the Lubelskie Voivodship are much higher than the Polish average (in year 2012: PLN 300,8 per capita) • good soil and climate conditions in the Lubelskie Voivodship • increased foreign investment • high population density in the cluster area • constantly conducted research verifying the possibilities of using zeolitic tuffs in new areas of economy • formation of clusters agrees with the policy of strengthening innovation and improving the competitiveness of Polish economy • medium-term and long-term strategic (Polish and foreign) documents assume supporting cluster initiatives • localization of big economic entities on the border of two countries (Poland and Ukraine) provides a chance for foreign and cross-national economic cooperation regarding both business and research • creating a market of specialized production factors, among which knowledge and high-quality human capital are the most important • growth of the science and development infrastructure in the region and at the same time increasing its use by economic entities • creating a culture of innovation and entrepreneurship in the region • creating and developing production networks based on one big company or several companies • functioning of clusters in a particular region is connected with a more rapid economic development and expansion of the region and the growth of wealth of its inhabitants • in the nearest financial perspective support will be directed to clusters which are characterised by international competitiveness • zeolitic tuffs are a raw material which is environment-friendly and agrees with the eco-innovation policy of the EU • the concentration of higher-education institutions in the Lubelskie Region offers excellent conditions for obtaining the effect of synergy regarding the conducted research • above average science and development agricultural activity in the Lubelskie Region • increasing interest in clustering in Ukraine | <ul style="list-style-type: none"> • no reliable information regarding their producers, their offers, etc. • weak concentration of big enterprises in the area where the cluster will function • a breakdown of small-scale production • an economic crisis • the Lubelskie Voivodship is one of the poorest Polish regions • closing down of a big number of agricultural farms • degradation and depopulation of rural areas, caused by economic migration to other regions • a weakness of the Lublin business support institutions is lack of cooperation between institutions of a similar profile from abroad • development of the process of globalization • high cost of research into the use of zeolites • a lobby of business organizations connected with the traditional industries and raw materials used in their activity • from year 2016 onwards the functioning of clusters will be based on the market participation model, which means that the private sector shall become responsible for the formation, financing and management of clusters • local communities and entrepreneurs have poor awareness of the benefits resulting from clustering • scientific and business environments are not used to cooperating and there is no stimulus for cooperation development • a relatively low level of innovativeness of Polish and Ukrainian enterprises • non-public academic centres concentrate more and more on educational activity and do not conduct wide-scale research • a relatively weak transport infrastructure in the cluster area, especially in Ukraine • lack of strong research and development centres outside the province cities |

- research on application zeolitic tuffs
- information and communication (a common communication platform, communication and interactive website, regular meetings members of cluster, conferences, publications and periodic newsletters, creating common database)
- trainings (common cluster training programs, training seminars and workshops with the participation of external experts and employees of various cluster entities, internal internships, study visits and exchange of experience)
- cooperation (implementation of common projects, internal meetings of experts and exchange of experiences, cooperation with research units and academic institutions)
- marketing (the creation of transregional cluster brand, promotion, participation in construction and agricultural fairs, conferences, promotion on the website)
- transregional and international activities (international cooperation, participation in fairs and international conferences)

One of the main areas of cluster's activity are research in the application of zeolitic tuffs. Such research prepared so far: Lublin University of Technology, Lviv Polytechnic National University, University of Management and Administration in Zamość. The results of research concerned sorption properties of zeolites in relation to heavy metals, sorption properties of zeolites in relation to ammonium ions, foaming effect of asphalt using zeolites, structure and functional properties of asphalt samples containing zeolites or physical properties of lightweight aggregate modified zeolite adsorbents. However, a number of studies have shown that there is a need to further diagnose the possibility of application zeolite tuffs. In addition, the results obtained so far may give rise to conduct further experiments and develop comprehensive research.

The priority of cluster's activities should be information and communication, which are an essential element occurring in all industries. Efficient flow of information determines the development of cooperation between cluster members. According to this, in order to facilitate secure communication between cluster members should establish an internal system which supports communication between all members within the cluster. Internet portals also act as an important function of information and promotion as well. Through the website it is possible to exchange offers, information and messages between all cluster members. In the construction and agriculture sector reliable information about zeolite tuffs it is necessary. According to this, functioning of an efficient information communication system is the basis for the success of common business ventures. Promoting a strong brand is an essential element of the cluster promotional activities.

Extremely important in the functioning of the cluster is cooperation between members of the cluster and the flow of information between them. Therefore, it is necessary to develop and create:

- information and communication system
- the system of training and developing human capital
- the system of exchange of economic information

The cluster should create educational offer. However, this requires the cooperation between a group of companies and scientific units and regional authorities as well. Another important element is improving efficiency in the field of specialized training for employees in the construction and agriculture sector as well.

The main objective of marketing is to promote a regional brand products. Essential for this activity is to create task package aimed at building a positive image of the cluster and its participants as well. What is more, it is necessary to support the market sales of products offered through cluster. On the one hand, these are widely understood marketing activities, on the other hand these are initiatives of Public Relations. Coordination of common objectives in the field of marketing is extremely difficult, because the interests of individual members of the cluster can be different. Therefore, this is necessary to start work on building a common promotion strategy, which will include the objectives and principles that should be followed during making promotional activities. In area of marketing should be taken the following actions:

- creating promotion strategy of cluster
- preparing and distributing of promotional and informational materials about the cluster and its development and potential in the region

- preparing website/portal which will promote regional construction and agriculture sector
- creating a common brand, recognizable among customers
- preparing of regular information about the cluster to the media
- organization of regular seminars and conferences to promote cluster
- promotion of environmental actions taken by the cluster

Determinant of the effectiveness of marketing activities within the region and within the country is to create a recognizable brand cluster. The existence of such a strong brand adds credibility to all units operating within the cluster and creates a positive image of companies.

In area of cooperation, it is necessary to exchange the experience, knowledge and flow information between research units and industry located in different regions and intensify technology transfer as well. Developing effective mechanisms of cooperation between companies and research institutions and the creation of research and development facilities for the needs of the industry as well is an extremely important activity in this area. In this area we can use following activities:

- analysis of development trends of sector
- analysis of financing opportunities for research and implementation
- organization of information meetings with leaders of sector and leading research institutions
- develop transfer rules of results research and development common with universities and research units

Transregional and international actions in the contemporary world are becoming increasingly important, related to the processes of globalization of the world economy and European integration as well. With this elements are related better resource flow conditions and increased specialization of the chain value abroad. Activity in the cluster, which comes from the interactions with foreign clusters brings many benefits including the opportunity to learn and participate in international projects, make new contacts, increase exports and access to new technologies. The actions that can be taken in this area include:

- international trade fairs
- participation in international conferences
- cooperation meetings
- reports and research industries

In the contemporary time of globalization, cluster initiatives to an increasing extent influence to increase the share of the country or region in the internationalization of production and therefore an effective way of attracting new foreign direct investment. Operating cluster initiative will help to increase the attractiveness of business in Lubelskie Voivodship, and in addition will not only increase the flow of FDI, but will contribute to sustainable connection foreign investors to the national economy.

5 Proposed development directions of cluster

Appointment to life the Cross-border Zeolitic Tuff Cluster bringing together institutions which, in its commercial activities and/or economic, will use zeolite tuffs and make it possible to provide the potential of this innovative material with an indication of undertaking common projects in the economic processes. The potential of zeolite tuffs regarding to the construction sector allows their use as substitutes for cement. In addition, zeolites are used in the production of beton, plaster restoration, building mortar and asphalt mixtures. Through the creation of the cluster will be possible to achieve synergies using the resources held by members of the cluster: potential of human resources, commitment of research institutions and business environment institutions.

Contemporary economy is based on knowledge and human capital is one of the most important factors of the existence of companies. In the case of lack of these resources, businesses take steps to establish cooperation and then its strengthening. A significant barrier to business development can be a barrier of technology absorption, which is insufficient endogenous potential to preventing effective adaptation solutions available on the market. Barriers to effective acquisition of knowledge may be particularly high for smaller entities (especially for micro-enterprises and SMEs) providing in most cases of small human resources, very limited potential of capital or total

lack of it, limited in size R&D facilities and difficult access to external sources of financing, etc. (Directions and cluster development policy in Poland, the study of the Ministry of the Economy Department of Economic Development). Therefore, cooperation is particularly desirable for small entities, which usually have very limited potential development. Thanks to the cooperation, such institutions can take advantage of the more experienced players in the market, their skills often going hand in hand with knowledge, providing in return unused capacity. In addition, the benefits of cooperation within the cluster initiatives are also: a platform for the exchange of information about the environment, the new level meetings of entities operating within the cluster, as well as verification of business.

The development of the designed cluster initiative largely will depend on funding. Obtaining external financing seems to be justified in order to acquire institutions that could cooperate within a cluster. An interesting solution seems to be the new financial perspective for 2014–2020, especially two operational programs – Smart Development and Knowledge Education Development. Due to the fact, that the cluster of zeolitic technology is at the stage of formation and the formulation, it is necessary to perform a series of actions from following area:

- preparing of documents on which based the activity of the cluster—strategies of cooperation and the development and further marketing strategy as well; there is a need to establish principles of membership of entities which intend to enter the cluster structure; the strategy to strengthen cooperation allows those entities which participate in the cluster to associate themselves with the objectives and assumptions, which to a large extent can affect its implementation; the preparation of the marketing strategy will allow for the verification of business opportunities in the area of introduction to the offer of companies new products and services, and the acquisition of new customers as well
- gaining new institutions that could become members of the cluster, therefore its systematic development through a series of activities—conducting thematic cluster meetings, promoting the cluster initiative through leaflets, brochures, gadgets or newspaper articles dedicated to the sector press
- creating a platform/website which is a form of messenger between the institutions, members of the cluster; prepared website will be “business card” of initiated cluster and will influence on its visibility; these activities will improve access to information on formed cluster initiative and thus allow the expanding group of entities operating in the cluster
- organizing of databases for companies operating in the area of cluster initiative
- establishing cooperation and then its gradually tightening in order to the scientific research units, local government units and business environment institutions as well, operating in the Lublin area
- organizing of cluster office
- purchasing/realizing of fixed assets and intangible assets (expertise, analysis, patents, licenses, research results) and perform economic analyses as well
- organizing of training programs, workshops and conferences to support transfer of knowledge and networking between the participants of the cluster
- internationalization of created cluster initiative, which will lead to mutual exchange of experience and will help to intensify the transfer of technology from the most innovative centers in Europe; as indicated, the internationalization of cluster initiatives is marginalizing the more the internationalization of clusters is becoming increasingly important, which is inextricably linked with the processes of globalization of the world economy and European integration as well, in addition, it is associated with better conditions of flow of resources and increased specialization of chain of value chain beyond national borders
- supporting initiatives in order to better fit educational programs to the needs of the regional market—based on the future needs for highly qualified personnel, cooperation of business environment institutions, research units and local government units in area of promotion of initiatives to create educational programs dedicated to regional market
- cooperating with other clusters, advisory networks or Enterprise Europe Network

- conducting of technology audits—on the basis of which they will be verified the needs of individual companies, this will help to determine the scope of organizational and technological change
- organizing trade missions with special emphasis on abroad, analysis of the possibilities of shares in selected trade fairs and cooperative exchanges in country and abroad as well
- translating from foreign languages selected articles for the operation of initiated cluster-in the area of exchange system of scientific and technical information as well

Conclusions

The Cross-border Zeolitic Tuff Cluster is an initiative, which will be result of the project „Description of an innovative model of cross-border application of zeolitic tuffs” carried out by University of Management and Administration in Zamość. It gives many advantages and the most important is: „Creating on Lubelskie Voivodship, Lviv Region and Transcarpathian institutionalized networks of cooperation scientific institutions, companies and NGOs in the field of economic use of zeolite tuffs. By creating a cluster it will be possible to establish cooperation between the following entities:

- centers of research and development, operating in the Polish-Ukrainian cross-border area
- enterprises from the Lubelskie Voivodship (Poland) and Lviv region and Transcarpathian region (Ukraine)
- inhabitants of Polish-Ukrainian cross-border area

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