

TABLE OF CONTENTS

THE COMPANY	1
THE BUSINESS OPPORTUNITY AND STRATEGY	2
THE COMPANY GOODS AND SERVICES	5
THE COMPETITIVE ADVANTAGE	8
THE COMMERCIAL VENTURE RISKS – FAQ	10
BVSORBEX TECHNOLOGY DESCRIPTION	11
MARKETS FOR ION EXCHANGE RESINS AND BIOSORBENTS	15
BVSORBEX MARKETING PLAN	18
COMPANY ORGANIZATION	19
FINANCIAL PROJECTIONS	22
THE COMPANY GROWTH	24



The Company



BV SORBEX, inc

BV SORBEX, Inc. is a privately owned company established in Montreal, Canada, to commercialize biosorption technology. The extraordinary potential of some natural materials to bind and concentrate heavy metals offers a promise especially in environmental applications. The Company possesses the unique know-how for the biosorption process. A family of newly discovered biosorbent materials is derived from selected seaweeds and industrial biomass generated as a by-product of large-scale (pharmaceutical) fermentations.

New biosorbents are very cost-effective in removing (and recovering) heavy metals from contaminated water or industrial effluents. They can be regenerated for multiple reuse just like ion exchange resins which they outperform in many applications while priced at about 1/10 of what ionex resins are selling for.

Cheap biosorbent materials can effectively remove toxic metals such as arsenic, lead cadmium or uranium from water as well as concentrate and recover gold. The application of biosorbents is broad: from detoxification of water or wastewater to recovery and resale of precious metals.

The Company has a number of new biosorbent products. It offers the biosorption water purification process and engineering services where metal toxicity is threatening the environment or water supply. This concerns particularly mining, ore-processing, metal-plating and such industrial operations as well as drinking-water supply. The process is based on simple flow-through sorption columns that can be easily adapted for many types of different large or small applications. The clientelle is indeed world-wide.

In the biosorption process the metals of value can also be recovered for recycle or re-sale. As the biosorption operation uses simple and common sorption columns, its applications are not only technically feasible but also economically very attractive.

BV SORBEX, Inc. is looking for clients and partnerships (world-wide) to bring the new technology of metal biosorption to its full commercial potential. Opportunities for piloting and installations of biosorption water treatment process columns are welcomed for different types of metal toxicity removal in different parts of the world.

THE BUSINESS OPPORTUNITY AND STRATEGY

ENVIRONMENTAL PRESSURES

- Reflecting the ever-increasing public pressure, the Water Quality Control Act in the USA and similar recent legislations in Canada are imposing and strictly enforcing progressively lower limits on toxic discharges by industrial operations. Increasing environmental regulatory pressures have become critical to an increasing number of industrial operations.
- The compounding toxic effects of heavy metals in the environment are being recognized and their dangerous impacts better understood. The threat to the environment and human health from heavy metals has been well documented for many specific instances.
- The currently practiced technologies for removal of heavy metals from industrial effluents appear to be inadequate, creating often secondary problems with metal-bearing sludges which are extremely difficult to disposed of. Due to their classification as “*toxic substances*” they require special handling, discharge methods and sites. Their disposal is closely monitored by the governments.
- The currently available “best treatment technologies” for treating metal-bearing wastewaters are either not efficient enough or are prohibitively expensive and inadequate considering the vast wastewater quantities requiring effective treatment in order to meet the final, increasingly more stringent disposal criteria.
- Conventional wastewater treatment plants, industrial and municipal, are expensive to build and operate, and they provide no economic payback.
- Industries that discharge into a city sewer system are assessed their “fair share” of the capital costs to expand, modernize, or upgrade the system to meet the increased loads. Thereafter they must pay their “fair share” of operating costs. These surcharges are becoming prohibitive rendering this alternative unfeasible.
- In many instances concerning metal-bearing effluents, their toxicity is excluding them from municipal treatment and efficient pretreatment procedures are required to meet the low metal content limits.
- Strong economic incentives exist for efficient residual metal recovery that makes the wastewater treatment processes more economical through at least partial recovery of costs based on benefits from metal resource recycling or resale.

The combined environmental pressures and economic stimuli make the removal and recovery of residual heavy metals from industrial effluents an important and ever-increasing priority. Serious health hazards are in aquifers and drinking water sources contaminated with heavy metals.

Both types of water remediation represent extraordinary business opportunities.

BV SORBEX Inc. believes that the above market characteristics have the following -

IMPLICATIONS

- 1) New efficient and considerably cheaper technology is the only answer to the problems inherent in meeting the current mandatory treatment standards and especially those being currently enacted to be enforced in the near future.
- 2) Lower capital and operating costs must be concomitants of the new technology; neither industry nor local government can afford to pay the capital and operating costs required by conventional technology, or to neglect the consequences of prolong discharges of toxic heavy metals into the environment.
- 3) Recovery of wasted metals and their recycle into the process offers a dramatic possibility for reducing costs. As such, it promises to be the spearhead of the new technology which is both environmentally and economically driven.
- 4) In-house pretreatment processes will be the most cost-effective solution for many industrial processors who would otherwise be heavily penalized for their waste “loading” into municipal systems.
- 5) In-house pretreatment systems will also be most effective for many industries with different scattered wastewater “point-sources” and for those which will be expanding their production.
- 6) Increasing demands are for those treatment technologies that do not generate “toxic sludges” (progressively more difficult and expensive to dispose of).
- 7) An increased awareness of the cost of acquiring, handling, and treating water and the shortages thereof will increase the demand for recycling and reuse of waste water.
- 8) Upgraded technology will make present standards of resource utilization, toxicity control, and sludge disposal patently obsolete.
- 9) Environmental and inflationary trends are bringing the pressure on industry and government to find better ways to treat waste water more efficiently and at lower operating costs.

The current conventional wastewater purification technologies have served the industry well under relatively lower pressures of the environmental regulations. However there has always been a problem particularly with metal-bearing wastewaters which are difficult to treat effectively and *economically*.

Toxic metals escaping into the environment have been confirmed to get concentrated in the food chain endangering the population and its food sources in an unprecedented manner.

The contamination of drinking water sources and underground water table by toxic metals poisons large populations. Stricter water-quality regulations mandate new water purification processes that remove toxic metals from (waste)water.

The metal-removal process must be effective, reliable and affordable.

WATER DETOXIFICATION – METAL REMOVAL

The first objective of B.V. SORBEX, Inc. is to penetrate quickly the special water purification market with its new technology and to establish biosorption technology as an effective and economical alternative to detoxification of industrial wastewaters by removing the dissolved heavy metals. With its first family of new (bio)sorbent products the Company will exploit the opening need (created by conditions described above) for cheap and reliable heavy metal removal/recovery from industrial effluents and/or drinking water sources. The initial technology focus is on wastewater detoxification which is today the single most important environmental issue representing an enormous market potential for low-cost system applications which make the wastewater purification schemes a feasible proposition for the target client industries.

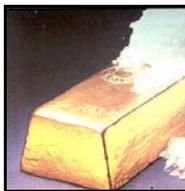
SUPERIOR TECHNOLOGY

BV SORBEX, Inc. has the unique know how and expertise in the new and cost-effective biosorption technology for heavy metal removal. That makes the Company a *leading force* in the field of water detoxification.



Marketing and sales efforts are concentrated upon developing the application schemes for the new family of biosorbent materials. This will be done in close collaboration with carefully selected client industries representing typical metal-related wastewater disposal problems. The current metal removal technologies practiced either do not meet the new regulatory criteria, e.g. metal precipitation which leads also to serious and costly problems with sludge disposal, or they are prohibitively costly and unsuitable for treating large volumes of waste streams usually generated (membrane processes, ion exchange).

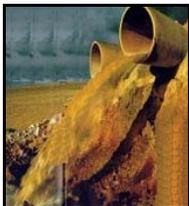
US\$ BILLION POTENTIAL



The current world-wide market for ion exchange limited to heavy metal applications is in the order of 5 billion US dollars per year with more than - 2 billion dollars in North America alone.

The ion exchange process for water treatment purposes is considered a “cadillac” of the treatment for the high costs of ion exchange resins. Biosorbents can be marketed for a fraction of the ionex costs establishing themselves thus as extremely *competitive products* capable of opening whole new markets unavailable to high-priced conventional technologies.

SELECTED CLIENTS



All biosorbent products will be tested first by several leading customers with whom B.V. SORBEX, Inc. has already established close relationships. The Company has already encountered strong market reaction to the announcement of performance and potential of newly discovered biosorbents which has been released in the form of technical results published in scientific literature and reported at international meetings. There are over a dozen client industrial enterprises anxious to test the materials which are not marketed as yet in sufficient quantities. Their commercialization is the goal of BV SORBEX, Inc.

THE COMPANY GOODS AND SERVICES

BV SORBEX, Inc. has a clear product strategy driven by the realization that the output of new production-scale wastewater purification systems must necessarily meet the regulatory standards and the treatment costs should not provide a major burden on the operators. In terms of introducing the new biosorbent technology and building an enterprise based on it the goal involves the enabling technological and engineering advances in three areas:

- **PRODUCTS**
- **EQUIPMENT**
- **SERVICES**

The three are interrelated; for example, new and highly competitive “products” - biosorbent materials enable application of the “equipment” - sorption systems - in the treatment process which has not been feasible up to this point in time when based on conventional metal-sorbing materials. The “services”, in turn, are to help convince the clients that the new “products” in the process “equipment” will work for them effectively and economically, helping them to solve their waste problems and, eventually, even help to offset the treatment costs by recovering the useful metal commodity.

Correspondingly, during its first three years the Company will bring to market:

• **PRODUCTS**

At least three unique and proprietary SORBEX-family biosorbent products:

- 1) A broad-range metal-sorbing material based on waste industrial microbial biomass;
- 2) A broad-range metal-sorbing material based on marine algal biomass;
- 3) A metal-specific biosorbent for high-value metal recovery.

• **EQUIPMENT**

A unique, possibly portable, pilot plant facility for the use and biosorbent technology demonstration on the location of the client production plant:

”*BeePS*” - Biosorbent Pilot System

• **SERVICES**

A range of environmental engineering services and analytical capabilities necessary for the review of the customer’s wastewater problem, leading to and including the treatability study aimed at assessment of the new biosorbent technology potential for the particular customer.

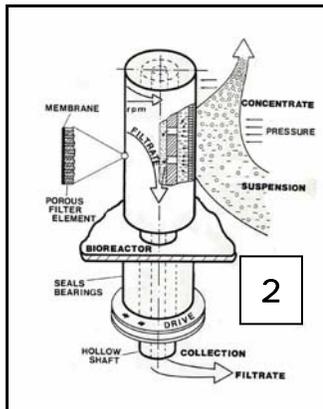
SORBEX BIOSORBENTS *The family of new biosorbent materials for metal removal/recovery*



The SORBEX-family biosorbents are based on a rigid and chemically robust formulation of highly metal-sorbing biomass raw materials. The biosorbent granules of 0.5 to 2 mm allow their convenient use in the sorption process contact equipment (columns). Their macroporous and hydrophilic structure makes them resistant to fouling and allows easy and rapid penetration of metallic ions from the surrounding solution and their binding. Biosorbents are easy to regenerate and suitable for multiple-cycle use in repeated metal uptake and sorbent regeneration cycles. BV-SORBEX family of metal biosorbents are quite specific for binding heavy metals, removing thus the toxicity and enabling metal recovery.

The Company has an exclusive know-how for producing and exploiting biosorbent materials discovered and developed over almost two decades of research into biosorption. The overall benefit to the customer of using BV-SORBEX materials will be an important reduction in costs of wastewater treatment resulting from the use of effective metal-sorbent materials of exceptionally low costs. In certain client cases the application of new biosorbents will enable to simplify the treatment process making it possible to accomplish satisfactory treatment of wastewaters, impossible with the conventional technologies. Undoubtedly, this factor will be the key to a significant expansion of the existing markets.

EQUIPMENT *BeePS - Biosorbent Pilot System:*

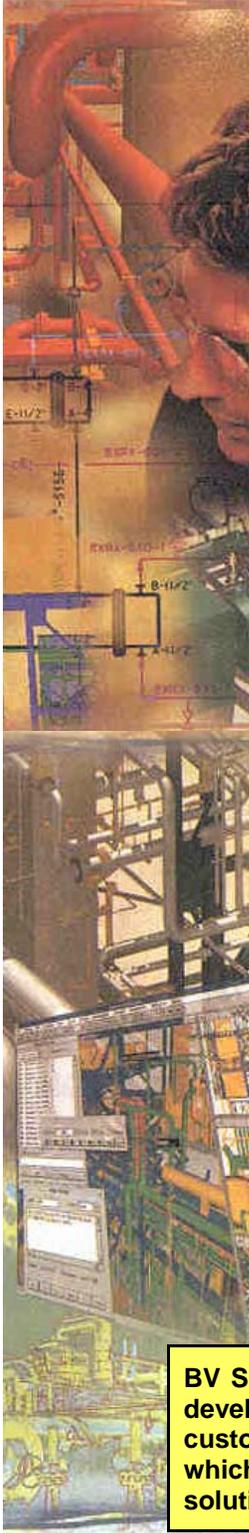


“BeePS” is a partially automated, self-standing pilot-scale equipment module for the sorption process. Its centre piece is the flow-through sorption column and it is to be marketed for pilots early in the Company development stages. Two basically different designs of the contactor element available for the *BeePS* make the pilot system extremely flexible and suitable for testing of a wide range of sorbents as well as different types of effluent solutions. Apart from the contactor heart of the system, each *BeePS* module is equipped with appropriate pumps, flow-control devices, valves and basic controls. As accessories there will be holding tanks for the fresh column-regenerating solution and the concentrated metal-laden regenerant. The system is designed for the use of both conventional ion exchangers and new SORBEX biosorbents.

- 1) One type of the *BeePS* contact system is based on the use of two sorption fixed bed columns operating in a standard alternating uptake/regeneration mode.
- 2) The other type of the *BeePS* contact system is based on a novel and *proprietary design* which allows continuous purification of an *unclarified* incoming stream containing suspended particulate matter. This feature eliminates not only the often required clarification pretreatment of the feed stream but allows also for the possibility of using of non-granulated and thus much cheaper biosorbents. The non-packed nature of the contactor allows a long-term continuous-flow operation without fouling. It offers faster kinetics of the sorption process which can be based on much smaller active particles allowing their more efficient utilization. This unique contactor is a substantially advanced form of a process equipment that prevents clogging and enables a different mode of biosorption process configuration. Extensive experimental evidence already exists of its technical feasibility and particle-separation performance in process use. .

**ENGINEERING
SERVICES**

Environmental Engineering Services by BV SORBEX
for Wastewater Treatability Studies and Treatment Plant Operation.



This most general of the BV SORBEX business opportunities is anticipated to be the source of the first *cash flow* for the Company and may grow to a substantial part of its business.

The industries discharging metal-bearing wastewaters are hard pressed by the new environmental regulations. In most instances their expertise is far remote from that required to control their wastewater qualities. This situation creates enormous business opportunities for consulting companies active in environmental engineering. Those companies, however, have mastered and offer, almost as a rule, only very conventional water control and management technologies. As much as they try to keep abreast of new technological development, they are not necessarily the prime movers and carriers of it.

When a new technology is developed, such as biosorption for treatment of metal-bearing wastewaters, it offers a rare opportunity for the pioneers of it to enter an otherwise very competitive field of environmental engineering with a head start and a great deal of advantage in possessing a new know-how and a *proprietary new technology* which fuel the success of a new enterprise in an otherwise conventionally competitive field.

It is also extremely advisable to maintain the control over the introduction and operation of the new technology out in the field in order to eliminate blunders of uninitiated operators which can prove costly and rather dangerous to the new technology and its reputation, possibly tarnishing also the credibility of the new enterprise. It is therefore mandatory that BV SORBEX be intimately involved with the introduction of its new biosorbent technology and its applications. The close involvement with client customers and good understanding of their processes as well as wastewater composition and flow patterns is a prerequisite for the decision on the treatment scheme which may or eventually may even not involve the new technology of biosorption. Particularly in the field of pollution control, the most rewarding advances and related sales are usually made in a very *close contact with the client* who may not even have been well aware of what his actual pollution related problems were to start with.

BV SORBEX plans to aggressively follow up on the client industry contacts and develop the solution to the wastewater treatment in close collaboration with the customers in a series of steps known as the wastewater "treatability study" which will not be elaborated upon here. The result is a tailor-made effective solution to the problem, satisfied client and a business opportunity well fulfilled.

THE COMPETITIVE ADVANTAGE

The Company possesses several key competitive advantages:

- Unique products, nowhere else available, serve as a basis for a novel technological approach to the removal and recovery of heavy metals from waste industrial solutions.
- The low cost of the new SORBEX biosorbents represents an extremely important competitive edge.
- Novelty of biosorbent materials and the fact that the Company is right at the source of their discovery put it in the enviable position whereby there is virtually no direct competition in the same area and no other vendors of the same products.
- Strong and new multidisciplinary technology and proven ability to reduce it to highly competitive products and services.
- Unusually close ties with a leading academic institution where the new technological know-how has been developed and resides. This close relationship will perpetuate the Company's technology leadership.

The SORBEX family of new biosorbents is based on original research and discoveries which make them of proprietary nature. Their use will provide the customer with significant cost savings in the wastewater treatment process and in the better efficiency in the metal resource utilization.

While there were several attempts at similar enterprises in the area of biosorption, BV Sorbex, Inc. has remained as the undisputed leader. Two other 'biosorption' companies, Bio-Recovery Systems, Inc. (New Mexico, USA) and AMT (Colorado, USA) that started up in the early 1990s, just did not have the appropriate technical know-how, good product basis (biosorbents) and they fatally mismanaged their start-up. Considering the immense business clout and financial resources of the handfull of extremely powerful multinational chemical companies producing and marketing ion exchangers, their *direct competitors* simply did not have a chance. Both of these start-up companies did not have the product cost advantage to set them sufficiently apart from the commodity-based ion exchange field.

Given the enormous market size, proven for ion exchange resins, and its expanding potential, there is obviously a generous room for parallel and even competitive efforts in the area of biosorption which is based on materials that cost only 1/10 of the ion exchangers price. If competition develops in biosorption it is probable that it would not have an entirely negative impact on the leading enterprise of BV SORBEX, Inc., since competition would assist in opening and establishment of new, pent up and so far untapped environmental markets representing a large hidden business potential indeed.

MAINTAINING THE LEAD

Any new venture with the potential forecasted in this plan must expect significant competitive response eventually, as it increases in size and visibility proving that the market need and potential truly exist. Particularly, considering the extreme commercial “muscle” of the few huge chemical multinationals who control the ion exchanger market, serious price war can be expected from them since biosorbent products do represent some competition to ion exchange resins. However, the enormous difference in price of biosorbents will undoubtedly make the biosorbent technology a target for either *partnership* or even a takeover which in either case may be of a great advantage to the Company owners and investors. BV SORBEX Inc. has developed the following strategies to ensure attainment of its objectives regardless of the competitive elements:

- 1) Maintain rapid growth rate so that BV SORBEX will always remain the leader in the field. Basically, to maintain the leading position – run faster than any potential competition.
- 2) Develop superior technical expertise in the wastewater treatment area which will reinforce the Company’s initial entry into the service field supplementing the product manufacturing and goods and services sales activities.
- 3) Develop superior product and system marketing expertise in following up on the consulting contacts with the prospective clients based on the review of their wastewater problems and treatment options.
- 4) Maintain low production costs to ensure that no competitor could undercut BV SORBEX prices without selling at a loss.
- 5) Maintain extremely vigorous R&D program in close liaison with academic institutions which will make it affordable.
- 6) Continue rapid technological innovation so that imitators compete against obsolete biosorbent materials, discontinued products and techniques.
- 7) Maintain maximum patent protection and rigorously enforce patent rights.
- 8) Maintain a source of lease financing so that customers can acquire BV SORBEX System with minimum capital outlay.
- 9) Keep a low corporate profile in each target market until the Company is ready to penetrate rapidly and in depth.
- 10) Avoid reliance upon projections that require significant penetration (over 40%) in any target market.
- 11) Maintain alternate sources of supply for all key raw materials and equipment components.
- 12) Provide attractive working environment and compensation structure in order to minimize employee turnover and neutralize the appeal of competitive offers to key personnel.
- 13) Avoid disclosure of profitability. The Company expects to keep distribution of operating results to an absolute minimum.

COMMERCIAL VENTURE RISKS

"IF THERE ARE NO RISKS, IT IS NOT A VENTURE. IN A VENTURE THERE ARE NO GUARANTEES..."

The new technology venture is associated with a certain element of risk that can be divided into these *categories*:

- - technological risks
- ▶ - market risks
- - enterprise growth or management risks

SUMMARY (Details elaborated in the full Technology Description and Business Plan) :

CATEGORY

POTENTIAL RISK:	COMMENT:
● New biosorbents will not work properly in the industrial environment:	Risk reasonably low. Preliminary tests indicate good performance even with industrial solutions. Standard individual "treatability studies" are mandatory for each special treatment case.
● Biosorbent regeneration will not be possible:	Not usual but a <i>possible risk</i> in some <i>special cases</i> . Biosorbents could be so cheap that even once-through use with or without metal recovery is feasible.
● Biosorbent life-time will be too short:	Minimal risk. Tests indicate good stability. Physical granule reinforcement technology known will be further optimized.
● Difficulties with the process application scale-up:	Minimal risk. No difficulties perceived due to long-time experience with well established sorption and very similar ion exchange processes.
▶ Biosorbent price will not be competitive:	Minimal risk. Their low price is guaranteed and their performance so far looks exceptionally well.
▶ The market has been overestimated:	No risk. Market for the closest similar product (ion exchangers) is strong and increasing. The biosorbent share of the market has been estimated very conservatively.
▶ "Soft" environmental market:	Overall minimal risk. All agree that environmental market will not diminish - strong long-range growth forecast.
▶ The competition is too strong:	Low risk. Virtually no biosorbents competition exists. Established and strong ion exchangers are in a different higher-priced "league".
○ The venture capitalization not adequate:	Low risk. Estimates are as good as can be. Biosorbent applications are very near indeed.
○ Not an adequate management team:	Excellent full structure and team will be established as soon as the financing is promised or in place. University expertise now available.
○ The projected Company growth is dubious:	Low risk. Very realistic estimates based on the current status of the technology and market needs. Growth well attainable.
○ The return on the investment is too distant:	Biosorption is a <i>very significant technology</i> with far reaching perspectives. Similar ion exchangers have been developing for 50 years into a \$16.5 billion/y world-wide industry.

BV SORBEX

TECHNOLOGY DESCRIPTION

BV SORBEX technology is based on extensive research work of the recent two decades that resulted in the discovery of especially potent and durable metal-binding biomass types that bind and immobilize heavy metals. This technology is capable of effectively and economically remove heavy metals from industrial aqueous solutions and wastewaters. The metals of sufficiently high market value can subsequently be recovered and re-sold. US Patents No. 4,769,223 and No. 4,320,093 and a Canadian patent No. 1,143,077 issued to protect the process technology relevant to some metals, more patents may be filed.

The core of this technology is a family of biosorbent materials (BV-SORBEX™) which can selectively bind and immobilize dissolved toxic heavy metals. These unique biosorbent materials are derived from specific types of biomass through simple procedures. An extremely cost-effective biosorption process is easily applicable on a large-scale. Granulated biosorbents are regenerative and can be reused in multiple adsorption/desorption cycles in standard equipment.

BV-SORBEX™ Family of Biosorbents*General Characteristics*

SORBEX-type biosorbent materials normally exist either as powders or granules of classified size ranges between 0.1 and 3 mm with a density slightly greater than that of water. They can also be as unclassified varied size particulates.

SORBEX granules are capable of extracting heavy metals from aqueous solutions (wastewater) or process streams. This special property is particularly useful for eliminating the need for costly and cumbersome chemical pre-treatment of toxic metal-bearing effluents. Sludge, an undesirable yet unavoidable byproduct of chemical pretreatment, is not produced in the application of SORBEX materials, and so the costs of sludge disposal are avoided.

This novel technology provides an economical alternative to the expensive ion exchange applications and particularly to landfilling of hazardous sludge wastes. In most cases the metals can be recovered and recycled.

The technology employed in forming the SORBEX granules distributes metal-binding sites not only on the surface of sorption particles but throughout the granule itself, so that the area of metal uptake is significantly increased. The characteristics of proprietary and unique new SORBEX biosorbents make them an ideal media for treatment of metal-bearing industrial wastewaters enabling also an economical metal recovery.

Metal Selectivity

Being derived from different natural raw materials, SORBEX family of biosorbent products represents a wide variety of possibilities due to their individual metal-sequestering properties. The broad-spectrum SORBEX materials are not selective in the heavy metals they sorb. They tend to simultaneously remove several different hazardous metals from the solution regardless of their differing concentrations. This makes biosorbents vastly superior to numerous conventionally used and costly ion exchange resins. In addition, these SORBEX materials remove only those metals which are considered hazardous, and allow non-toxic alkaline earth metals (Ca, Na, K, Mg) to pass, reserving all possible sorptive sites for hazardous heavy metal species.

Metal-selective SORBEX materials are formulated to be very specific in their choice of metal they bind. Good selectivities have been achieved for instance for Cd, Cr, Cu, Zn, Pb, U, and Hg, all highly toxic. Even gold can be recovered.

No Concentration Dependence

SORBEX biosorbents load single or mixed metals independent of influent concentrations; therefore they function as effectively in solutions containing concentrated (100's of ppm) metals as they do in relatively dilute streams (less than 10 ppm). This

property is especially valuable in industrial situations that produce wastewater streams with varying metal concentrations. These biosorbents are extremely efficient in scavenge and concentrate metals present even in very minute quantities they making their recovery feasible.

High Efficiency

SORBEX biosorbents load single or mixed metals in excess of 10% of the sorbent dry weight. They have metal-removal efficiencies of >99.7%, yielding effluents with total metal concentrations of less than 10-50 ppb. This is more effective than with other metal removal methods.

High Versatility

Many SORBEX biosorbents function generally over a wide range of pH values (pH 4-10) as well as temperatures (5-75°C) with no change in efficiency. Those formulated for a metal-specific function may require, in some cases, better specified process conditions in order to operate most effectively. The process equipment required for the application of these biosorbents is of a standard sorption contacting type. Most often it would be a sorption (trickle) column simple to operate, maintain and modify. The process can operate outdoors, and may be used in industrial or remedial action applications. In the latter case, the ability to treat lagoon or groundwater without pretreatment makes SORBEX biosorbents extremely easy to apply even in mobile treatment unit operations.

Tolerance to Organic Contaminants

SORBEX biosorbents are not affected by low level (<5000 ppm) organic contamination. Although SORBEX materials do not treat or significantly sorb the organic fraction, they can be used in conjunction with other technologies in order to detoxify mixed aqueous flows. The physical properties of SORBEX biosorbents make it possible to use them in fluidized bed systems, which allow suspended particulate matter to pass through the SORBEX process bed and thus prevent fouling.

Regeneration

After they are fully loaded with metals, SORBEX biosorbents can be regenerated and then reused. This eliminates the need for constant biosorbent replenishment resulting in an improved economy of the process. In some applications, the regeneration

of cheap biosorbents may even not be practiced as they may be used on a once-through basis and when they become saturated, they could just be simply incinerated. The metal becomes then concentrated in the small volume of ashes that can be either easily disposed of or processed for metal recovery.

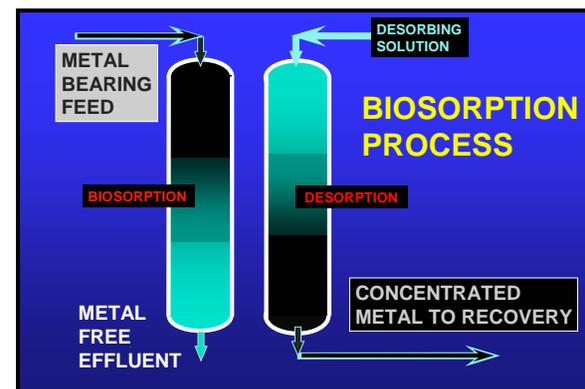
Regeneration of loaded SORBEX biosorbents is normally accomplished through a two-step process. In the first step, the loaded metals are stripped from the biosorbent by the application of either alkaline or acidic solution, or by an appropriate chemical solution of a proprietary nature. The reactivated sorbent is washed in the second step. Some SORBEX biosorbent materials can be regenerated/reused by the customer up to 50 times.

Regeneration of the biosorbent takes place either *in situ*, in the same process equipment, or separately from where the active metal uptake originally took place. Metals stripped from the loaded biosorbent become concentrated in the regenerating solution and may be recycled and reused by the producer or be recovered from the solution by an electrowinning process to yield cathodic metal. This is often done by a specialized metal recycling plant.

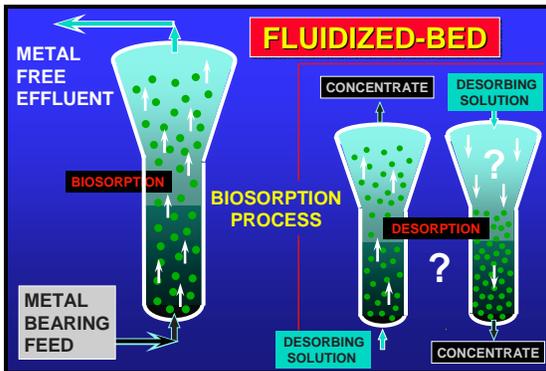
Process Application Equipment

The utilization of biomass, combined with the proprietary processes of SORBEX formulation and granulation, produce biosorbents with characteristics that allow great flexibility in engineering process design and applications. This versatility, plus the significantly faster sorption kinetics of SORBEX biosorbents, is unequaled by traditional ion exchange media. These properties, in addition to those cited above, allow to engineer highly effective yet simple industrial metal-removal systems. These systems are of three basic types:

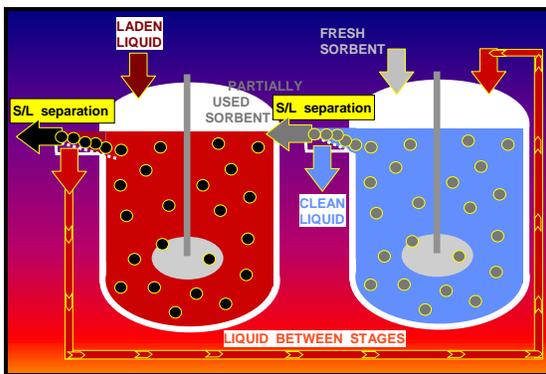
1) Sorption column(s) (or the fixed-bed system):



2) fluid bed system (also in columns):



3) Completely mixed tanks (counter-current):



The Sorption Column System

The system utilizes the SORBEX granules as a packed bed of extremely high surface area. Wastewater stream is fed from its source to an equalization tank where it is held until it is ready for treatment. It is then pumped, at a predetermined rate, from the tank into the first of usually two SORBEX-packed columns.

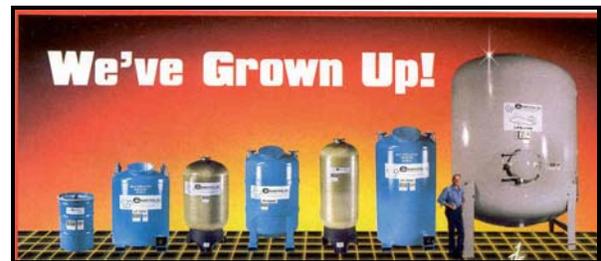


There is a great inherent advantage in using columns for sorption – they can come in a range of sizes. From very small “cannisters” (even portable) to the largest size as seen in the picture. For high flow-rates, columns can be multiplied into sets of many (parallel) for unlimited process scale-up.

Column systems, available in a variety of sizes, can accommodate a wide spectrum of flow requirements and process performances. Columns are cylindrical of variable sizes from 3cm (1.5 inch) to the maximum size not exceeding ~1m diameter and 4m height. They are filled up to about 3/4 with active biosorbent. A single column can accommodate flows from about 500 gal/d to 10,000 gal/d.

Flow of the waste stream is directed downward through the column. The biosorbent in the column actively removes toxic heavy metals from the solution as it passes through the bed. The stream then may even flow into a second column, that would remove any traces of metal not sorbed by the first. Effluent leaving the second column has metal concentrations reduced to the 10-50 ppb range..

When the biosorbent in the first column becomes fully loaded, this column is removed and the second column, with its still unexhausted biosorbent, is moved to the first position. The fully loaded column no. 1 is then regenerated, and replaced in the process as a second one to carry out the polishing job. In this way there is always sufficient highly active biosorbent present in the system to remove metals from the incoming metal-laden solution to meet the effluent specifications. The figure below shows typical column systems.



Development of New Biosorbents

The process of biosorption has an exceptional commercial potential. Continued R&D activity that BV SORBEX is always close to assures its leading technological and know-how edge. All the key new discoveries are subject to patent applications assuring a strong proprietary position in the area of the new biosorbent technology.

Technology Description

Biosorption technology is based on extensive research work which resulted in the discovery of potent metal-binding biomass types. This technology is capable of effectively and

economically removing heavy metals from industrial aqueous solutions and wastewaters. The metals of sufficiently high values can be recovered and resold.

US Patents No. 4,769,223 and No. 4,320,093 and a Canadian Patent No. 1,143,077 issued to protect process technology relevant to some metals, more patents are currently pending. The core of this technology is a family of biosorbent materials (SORBEX) which can sequester metals either selectively or as a broad spectrum of metallic species. These unique biosorbent materials are derived from specific types of microbial biomass by a simple process which makes them applicable in large-scale sorption processes.

The granulated biosorbents can be regenerated and can be reused in multiple adsorption/desorption cycles.

Commercial Potential

Biosorption technology is a very effective method for removing metals from solutions featuring either high or low metal concentrations, even well below 100 mg/L. The cost-effective nature of biosorption guarantees an excellent competitive edge of this alternative metal-removal/detoxification process. Due to the low-cost nature of biosorption, it is foreseen as to be able open new and undoubtedly large environmental application markets that have not been tapped so far due to high costs of conventional metal-removal processes briefly described in the following section.

Conventional technologies for handling heavy metals-containing effluents

The most widely utilized practise of “avoiding” environmental hazards connected with spreading toxicity of heavy metals has been simple containment of effluents in *tailing ponds*. These have been widely utilized mainly by mining industries generatig by far the largest volumes of metal-bearing wastes. This practise, however, has serious side-effects and devastates large tracts of land. It has led to numerous and well publicized disasters.

Precipitation

of heavy metals often precedes tailing pond containment. It usually does not meet the current environmental standards and generates concentrated sludges that pose a serious environmental hazard and final disposal problems. More current competing technologies for removal of toxic metals from wastewater streams are few.

The main established competing technologies are ion exchange systems and reverse osmosis. A detailed competitive analysis report was already performed by independent consultants, conclusions of which are that:

Reverse osmosis, although performing well in most applications, it is commercially more expensive than ion exchange systems as it uses membranes and high pressure process.

Ion exchange systems are established and they are effective for removing low concentrations of heavy metals. However, the relatively high cost of synthetic ion exchange resins seriously limits their use, particularly in environmental applications. These man-made resins are derived from hydrocarbon raw material extremely susceptible to crude oil price fluctuations with an uncontrollable and mainly upward trend.

Opportunity and Clients for Biosorption

The cost-effective nature of the biosorption process in removing heavy metals places this novel technology in a interesting position of being able to open and successfully penetrate the pent-up potentially huge environmental clean-up markets. That is in addition to existing applications of ion exchange resins in this area. Their current market niche can be penetrated by cheaper biosorbents.

The industrial sectors which are being hard pressed for cleaning their toxic metal-containing effluents include:

- mining operations
- all metal/ore processing
- electroplating
- leather tanning
- battery/accumulator manufacture
- coal-fired power generation
- nuclear power generation

A special case pressing for immediate action is the (natural) **arsenic** contamination of drinking water in many regions of the world – acutely poisoning large population segments particularly in Bangladesh (**70 million affected people !**), China and India, but also in South America and even in the USA.

All of these sectors represent an excellent world-wide market opportunity for cost-effective clean-up technologies needed to satisfy the progressive regulatory effluent discharge demands that are more and more strictly enforced.

BIOSORBENT MATERIALS FOR METAL REMOVAL/RECOVERY

MARKETS FOR ION EXCHANGE RESINS AND BIOSORBENTS

The major competing technology for the family of new biosorbent products is that based on well established ion exchange resins. Ion exchange technology has been developing over the period of past five decades and it is considered a mature area marking a gradual but limited growth as the case is for all well developed technologies. In order to assess the potential immediate market share of the new biosorbent products which use the same process application mode as ion exchangers, it is essential to review the situation in the market of ion exchange resins.

The market facts concerning ion exchange resins which have grown into a commodity product with a multi-billion dollar sales volume – are well concealed in the overall sales of multinationals that rule the field.

Ionex Sales Volume

Ion exchange resins are used in all industrialized countries. Major production facilities exist in the USA., Japan, Russia, France, Italy, Germany, and the United Kingdom. In addition, plants in Canada, India, South Korea, China, Brazil, Mexico, and several Eastern European countries manufacture ion exchange resins for domestic consumption. In developing nations, tariff regulations frequently encourage local functionalization of imported copolymers to provide ion exchange resins.

World-wide production of synthetic ion exchange resins probably exceeds $1.5 \times 10^5 \text{ m}^3$. In deionization and water softening applications, ion exchangers can be considered commodity chemicals because of the characteristic excess production capacity, limited market growth, and intense competition. However, resins used in smaller markets, e.g. chemical processing, sugar refining, pharmaceuticals, hydrometallurgy, catalysis, and wastewater treatment, are classified more as specialty chemicals.

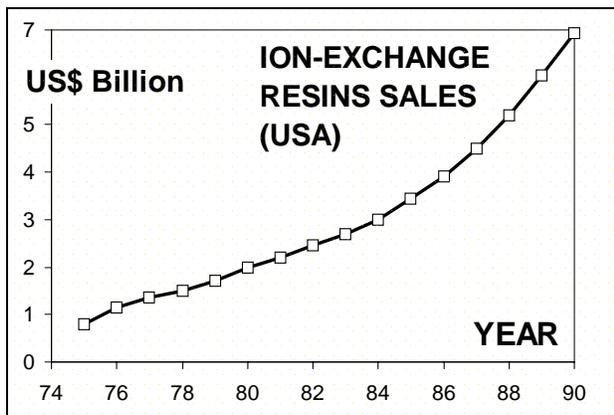
It has been extremely difficult, if not impossible, to find reliable quantitative estimates of the ion-exchange resin market. This is probably due to all the factors mentioned above and the market figures for ionex resins are hidden in the overall commodity production data released by the few transnational corporations involved. Correspondingly, the most diligent searching yielded only cursory information.

Recent Market Development

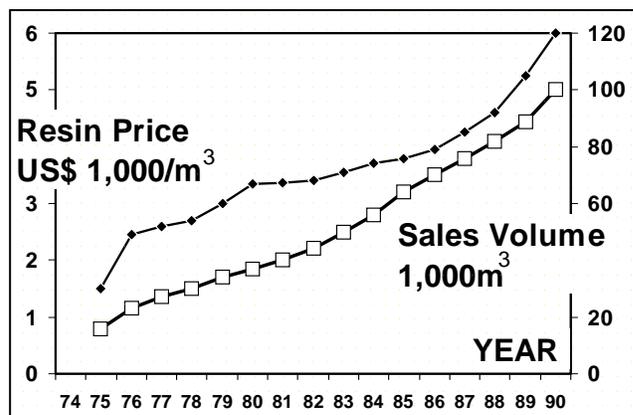
Small quantities (<15% of the market) of ionex resins are imported into the U.S. primarily because of lower prices; U.S. pricing and sales since 1975 are reflected in the Figures below.

A dramatic effect of oil price instability on resin prices has been seen already early, e.g. 1973 embargo, as styrene pricing is directly affected by the price of benzene from which it is made. Resin availability was severely curtailed then and prices rose correspondingly. The latter half of the 70s was characterized by a dollar value increase which resulted from a combination of inflationary pressures and real volume growth. The resin production volume growth partly resulted from the increased need to process poorer quality water, the resurgence of uranium processing industry and the additional use of ion exchange systems for sugar processing. Ion exchange resin sales have experienced an increased growth rate in dollar value in the early eighties, resulting still partly from inflationary effects. However, as the inflationary pressures eased off in the late 80s, the sales continued even stronger due to increasing market demands and broadening applications of ion exchange technology, particularly in the specialty chemicals domain. Obvious enormous strength of the market is in perceived applications of "clean-up" technologies due to the increasing environmental concerns.

ION EXCHANGE RESINS SALES (USA):



ION EXCHANGE RESINS MARKET (USA):



Ionex Market Volume

The total ion exchange resin sales volume in the US alone doubled from \$2.5 billion/y in 1980 to \$4.8 billion/y in 1986. These figures, reflected in the preceding diagram, indicate a strongly growing market. The main component responsible for this growth strength is the *speciality* component of the ion exchange business. The market for ion exchangers in post-communist countries is estimated to be about equal to that in the United States (in dollar value). It has been estimated that the latest total value of ion exchange resins sales world-wide (in the US dollar equivalent) amount to more than \$16.5 billion per year.

Projecting these total ion exchange sales figures into the "speciality" fraction of the ion exchange resin market represented by the non-commodity resins which do not exceed the 25% share of the total, the world sales volume for this category of ionex resin products has been estimated at approximately \$4.2 billion per year world-wide, with the North American share at \$1.6 billion per year as of the latest.

Ionex Market Limits

Approximately 75% of the resins sold in the United States go to home and industrial water pre-treatment with the balance divided between chemical processing, metal recovery, effluent and wastewater treatment and small finer specialty applications. A requirement for a competitive ion exchange material is such that it be available at such a price that its use in appropriate equipment is economically favorable over competing processes, e.g. distillation, crystallization, dialysis, reverse osmosis, electro dialysis, solvent extraction, etc. The market price of ion exchange resins is such that it seriously limits the feasibility of the process in truly huge area of wastewater treatment applications which is becoming increasingly more prominent due to mounting environmental pressures. It seems that this expanding market will belong to alternative technologies which can offer similar service at a fraction of the ion-exchange price.

Biosorbent Market Opportunity

The new discoveries and the pioneering R&D work on the new biosorbent materials have established their extraordinary potential in binding heavy metals. The major application and market opportunity for the new biosorbent materials is correspondingly seen in the field of detoxification of metal-bearing industrial effluents & metal recovery. Currently, these applications represent approximately 15% of the established ion exchange market. On a world-wide basis this represents a 15% fraction of the \$16.5 billion per year sales which is \$2.483 or approximately \$2.5 billion/year. Transposed to the North American fraction of about 1/3 of the world figure, this signifies current sales of approximately \$800 million/year worth of metal-binding ion exchange resins. A very conservative estimate could expect the new and cheaper biosorbents to penetrate that market to the level of at least 15%. Even with no expansion of the market, this represents a currently existing market opportunity amounting to \$120 million/year in North America alone.

Expanding Markets

The market share of biosorbents is expected to grow exponentially with their price edge which will tend to open new markets inaccessible to ion exchange resins due to their high costs: Current ionex resin price: \$50-70/kg

Estimated biosorbent cost: \$ 3-7/kg

With the application mode of the two "active" products being practically identical, the conspicuously lower price of biosorbents signifies a qualitative change in the market structure which is likely to open up with applications which were not feasible for conventional ion exchange resins. Nowhere else is this case as apparent as in the field of environmental applications. Large volumes of metal-bearing wastewaters make more expensive conventional treatment technologies prohibitive. As a result, these newly opening market opportunities for biosorbent products will not be accessible to ion exchangers. At the same time, the environmental regulatory pressures will obviously not subside, ever. Increasing strong trends toward preservation of the environment and recovery of resources provide a powerful stimulus for ever widening scope of biosorbent technology applications. The situation has been changing and the new market opportunities for the clean-up technologies being opened are truly enormous.

Market Opportunity for BV SORBEX, Inc.

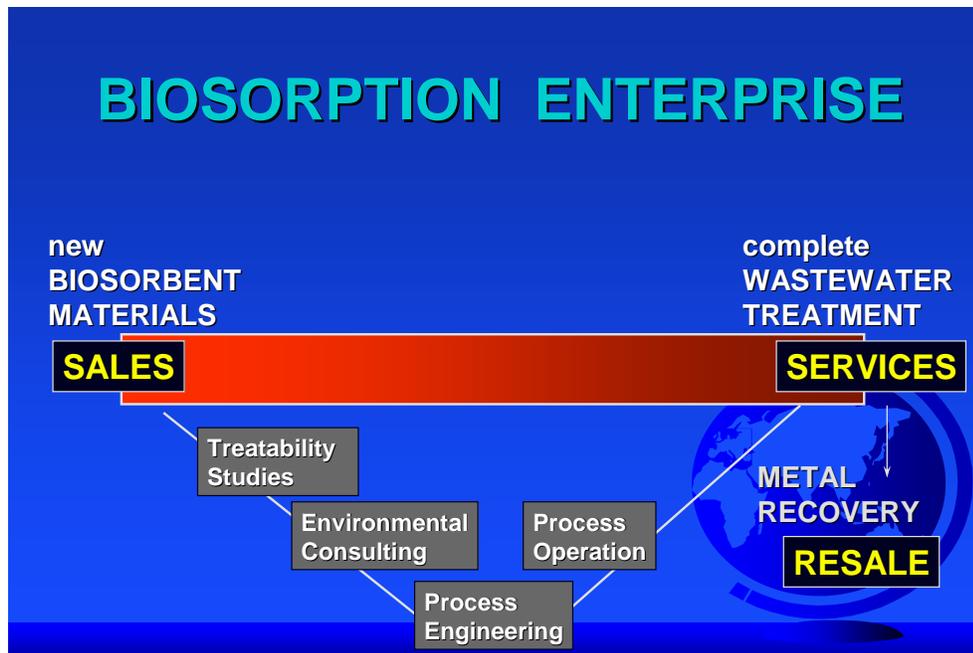
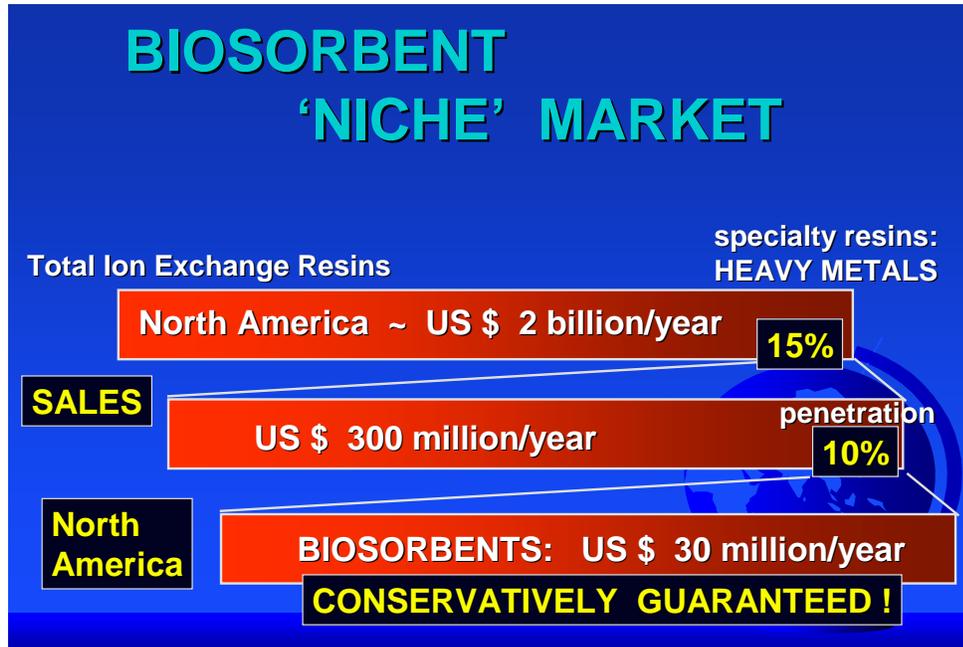
Products:

Further development of BV SORBEX, Inc. is backed by its current technological and know-how advantage. Provided that the corporate start-up phase and further growth of BV Sorbex, Inc. will be well managed, it can be assumed that it will developed into the leading enterprise in the new technological field. It would not then be unreasonable to consider that its market share could be secured in the vicinity of 25% of the total market for biosorbents. This translates to a very conservatively estimated currently existing market opportunity in biosorbent *products* for BV SORBEX, Inc. of approximately **\$28 million per year** in North America alone (see the chart on the next page).

Services:

The above product market share does not include the engineering service market component which is logically part of the BV SORBEX, Inc. business plan. In order for a new family of biosorbent products to find its best uses in well designed and efficiently operating applications, a host of consulting and engineering services has to precede and accompany the operation of actual effluent treatment plants. For best results, client-based treatability studies have to be carried out and product application schemes designed. The actual operation of the biosorption plants may also be contracted out by the client to the Company which may also be looking after the recovery of the metals removed from the solutions. Appropriate engineering back-up of the biosorbent products is essential. Realistically estimated *service* market currently exists in the order of **additional \$60 million/y** for North American biosorption applications alone.

The immediate initial market share of the biosorbent venture can be estimated from anticipated penetration of *existing* proven ion exchange resin markets :



Biosorption enterprise is intended to be *broader* than just selling biosorbents – selling equipment too. In addition, the spectrum of *services* from treatability studies to the entire process operation gives BV SORBEX, Inc. a wider, more dynamic and more flexible business base.

B.V. SORBEX Marketing Plan

MARKETING STRATEGY

of the Company is divided into three major lines with a common denominator of the new biosorbent technology:

- 1) ***Sales of a whole family of new biosorbents***
- 2) ***Sales of (environmental) engineering services***
- 3) ***Sales and operation of water treatment sorption plants and equipment***

The marketing strategy for the sales of the above mentioned goods and services can be summarized as follows:

- a) To establish its presence in areas of contaminated aquifer disasters (drinking water sources)
e.g. arsenic in Bangladesh, China, USA, etc.
- b) To identify and concentrate on industrial operations generating and discharging metal-bearing waste waters. These include very diverse but extremely large industrial activities such as:

- metal finishing and electroplating industry	- selected chemical industries
- metal processing industries	- battery manufacturing industry
- mining and ore processing operations	- photo and electronic industry
- thermal power generating stations	- leather tanning operation
- c) To develop expertise specific to each prospective industry client, so that the BV SORBEX technology becomes the preferred process for wastewater treatment and metal recovery in each, on its own terms.
- d) To carry out wastewater “treatability studies” (an engineering service) with industrial clients in a dialogue with appropriate government regulatory agencies. The treatability studies are a normal way of assessing the wastewater discharge problems and suitability of treatment schemes.
- e) To send highly trained professionals into the field in a direct sales effort of the sorbent products and equipment or systems leasing or sales.
- f) To provide BV-SORBEX Metal Removal/Recovery System available on a lease basis initially to industry leaders, subsequently to others in each industry to rapidly achieve the dominant position in each industry.
- g) To back up aggressive treatability and sales efforts with an engineering applications group.
- h) To make pilot plant systems available for use by prospective customers - a “seeing is believing” technique which is an important part of the wastewater treatability studies and proves most effective in the Company sales drive.
- i) To provide comprehensive technical support during the design, installation, and start-up phase of each sale or lease.
- j) To assist each client to meet the government regulations pertaining to the quality of the wastewater discharge.
- k) To operate the BV-SORBEX plant installation(s) for the client if such an arrangement is desired, guaranteeing the wastewater quality.
- l) To develop and maintain favourable relationships with the federal, provincial and local authorities involved in the wastewater quality regulatory functions.

*Considering that the market opportunities are developing similarly in other industrialized areas of the world, **BV Sorbex, Inc.** intends to form joint ventures and marketing alliances with partners in Europe, Australia, South America and Japan to fully exploit the **international** market potential.*

COMPANY ORGANIZATION

For developing the biosorption technology to the pilot stage, the Company is relying on the laboratory efforts based conveniently at McGill University in its home-city of Montreal (Canada). The link is provided by Dr. B. Volesky, the **President and Founder** of B.V. SORBEX, Inc. who is also a Research Professor with McGill University (Montreal, Canada). During the initial phase of the technology scale-up, the Company technical personnel and university researchers are working in concert under the direction of Dr. B. Volesky. It represents an extraordinary advantage particularly for the start-up phase of the Company that it can draw on the human resources pool of the University during the period of financing the Company venture. Access to and availability of the best trained, experienced, bright and dynamic personnel from the University is an extremely important asset. The most important resource for any enterprise is the human resource.

The **Board of Directors** is to oversee the overall direction of the Company, its development axes and its financing. The Board is selected from individuals with outstanding technical and financial expertise, and also representing the major private investors.

The **Executive Vice-President** is assisting with securing the capitalization of the Company. As the venture financing is in place, the Company will hire a **Director of Marketing** and as the first priority his group will assume and expand all sales and marketing activities and contacts with prospective customers – carefully selected for first piloting the biosorption process.

The efforts of the Marketing Division will be backed up by the **Engineering Services** team which, in conjunction with the laboratory-based technical personnel, will carry out the individual client-based wastewater treatability studies, and design and operation of the pilot plant(s) operated on location(s).

Eventually, spinning off from the laboratory team, there would be a **Product Division** which would have a complete responsibility for preparation of biosorbent products first to be used in the pilot plant(s) and eventually in the full-scale wastewater treatment installations operated either by individual customers or by BV SORBEX Inc. under a contractual arrangement. The Product Division will be headed by the Director of the Product Division, responsible to the Vice-President or the Chief Executive Officer. As it is of a standard nature, the sorption equipment (columns) and relevant process hardware could routinely be procured from outside suppliers.

An essential role in maintaining and enhancing the strength of any new technology is played by continuing, vigorous and innovative R&D. Eventually consolidated on its own premises, the **R&D Division** of the Company will undoubtedly benefit a great deal from maintaining close links with the scientific community on university campus(es) and in governmental and para-governmental research laboratories. Developing new and more efficient biosorbents and optimizing the process aspects of their applications, the R&D Division of the Company will be the responsibility of the Vice-President and R&D Manager.

WHO**MAN & EXPERIENCE***THE CHIEF EXECUTIVE OFFICER*

Bohumil VOLESKY, Ph.D. is the Founder and President of BV SORBEX, Inc.

Dr. Volesky brought into the Company results and know-how of 2 decades of pioneering research on biosorption. His experience in the new technology development and R&D management, together with extensive world-wide network of scientific, technical and business contacts established through his consulting activities, provide a solid basis for establishing a successful venture.

Dr. Volesky is also a Research Professor in the Department of Chemical Engineering of McGill University in Montreal supervising a research team. Full access to the University resources, laboratories, sophisticated equipment, and highly trained, experienced technical personnel is an invaluable asset particularly during the Company start-up stages and continuing quest for new biosorbent materials, optimization of their performance, and providing most relevant R&D support for the test and field activities.

The enlightened and dynamic university policy toward active University-Industry cooperation, encouraged by Canadian and Quebec science policies, is a guarantee of further benefits to the Company to be derived from being associated with a University of world renown. The generous and flexible patent and proprietary rights policy of McGill University are such that they actively encourage establishment of spinoff enterprises based on work done in University laboratories. The Company and Dr. Volesky have full rights to the biosorption technology and discoveries. The science of biosorption has recently been summarized and published in a comprehensive book on “***SORPTION & BIOSORPTION***”, written by Dr. Volesky, that has become the reference book for the field.

The University team working on the development of the new biosorption technology under the guidance of Dr. Volesky represents an extremely talented, highly flexible, well trained, and the most valuable human resource on which the Company can draw in its growth.

PROFESSIONAL PARTNERSHIP



EXECUTIVE VICE-PRESIDENT

Dr. Ghinwa NAJA is contributing to the Company her organizational skills, her experience in the field of biosorption as well as her valuable international contacts. Speaking fluently 3 languages (French, English and Arabic), she obtained her PhD in Physical Chemistry in Nancy, France. Her original research at the CPB/CNRS (1997-2001, France) expanded into the fields of biotechnology, molecular physical-chemistry, chemical engineering, analytical chemistry and systems analysis.

As the winner of a special UNESCO Fellowship for Women in Science (2004-2005), she was invited to stay at McGill University in Montreal as a Visiting Professor developing mathematical models and computer simulations for environmental and solid/liquid sorption systems. Recently, she also became a Research Fellow with one of the most prestigious research institutions in Canada, the Biotechnology Research Institute of the National Research Council of Canada. Her professional skills and extraordinary business accumen, combined with boundless energy and a genuine interest in advancing biosorption technology earned her a key appointment with the Company. For her achievements she also has recently been appointed to the Lebanese Legion of Honor.

PROFESSIONAL SERVICES

In addition and in support of its in-house expertise the Company has secured the services of outstanding professionals in specialized fields, including legal and financial services..

STRATEGIC ALLIANCES

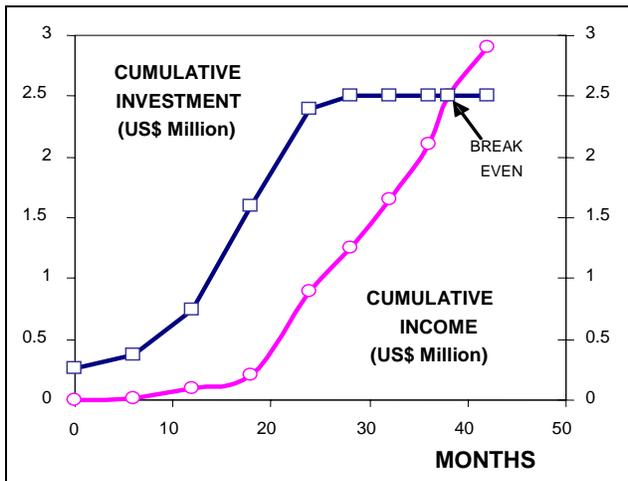
While the building of “strategic alliances” is a continuing process, some have already been established to aid the Company in its engineering, raw material procurement, and marketing tasks, correspondingly thus in the following fields:

Engineering and Applications
Equipment Manufacturing
Consulting and Applications

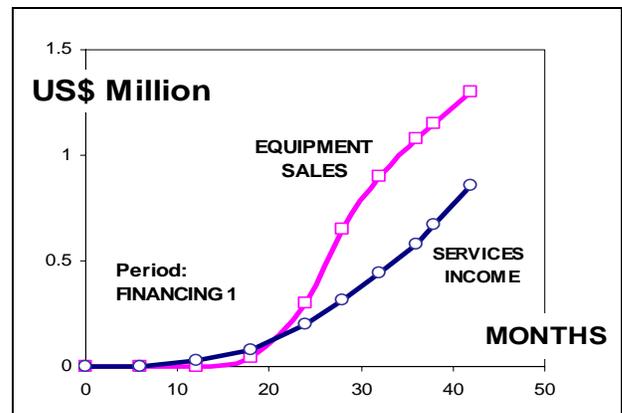
Consulting and Marketing
Biomass Material Procurement
Raw Material Pre-Processing

FINANCIAL PROJECTIONS

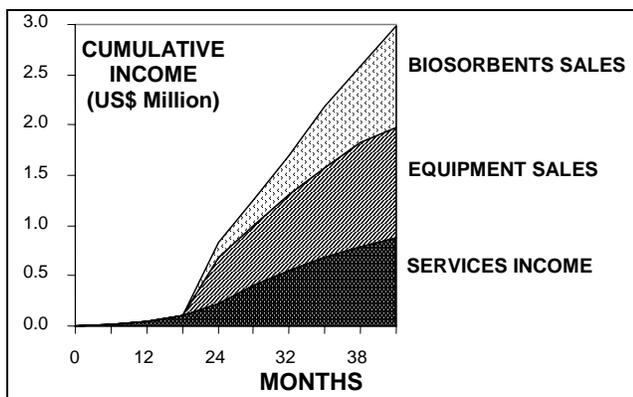
FINANCING 1 The Company will require two infusions of capital; a first one in the approximate amount of total **US\$ 2.5 million** to assist the Company development for approximately 3 years. Following this period of Company's aggressive entry into the three facets of the environmental market (Engineering, Equipment, Products) a positive cash flow is expected.



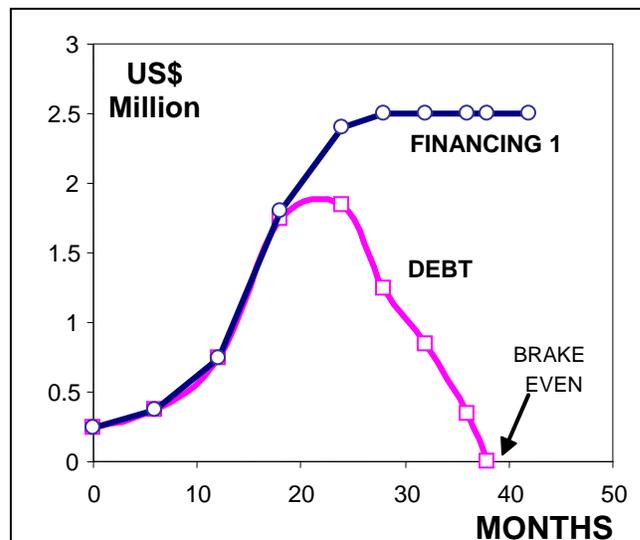
Financing Phase 1: Cumulative Investment Income



Services Income and Equipment sales



Financing Phase 1: Projected income from BV SORBEX Goods and Services Sales



Projected Company Indebtedness

FINANCING 2

The consolidation of Company's efforts and manufacturing facilities at this point (approximately 3 years after the fully financed start-up) will require another round of financing in the estimated order of **US\$ 3-4 million** which will propel the enterprise into an unlimited growth phase.

GOVERNMENT GRANTS



B.V. SORBEX is fortunate to be based in Canada where the climate for new enterprise is extraordinary. The unique Government policy of developing strong Canadian industrial enterprise results in unusual grant and financing schemes for new technology-based enterprises which offer 50-75% financing of new companies in the form of grants and additional schemes of generous loans and subsidies. In fully qualifying for this unusual level of financial assistance, BV SORBEX can multiply any private investment by a factor of 2 to 4.

RETURN ON INVESTMENT



Revenues from early engineering services and later product and equipment sales are expected to bring the Company to the financial break even point in slightly more than 3 years. At that point the equity value of the well established enterprise is likely to represent a good value for the investment. Both BV-SORBEX biosorbents and sorption equipment are high margin products, on average 85% and 63% respectively. The Company's financial projections call for net profit in approximately two years following the second round of financing. At that point, net profit after taxes is projected to be about 25%. The projected return on stockholder's equity (after tax) in that period is estimated at 40%.

BUSINESS BASIS



The financial projections were based solely on sales in North America of the Company's marketable goods and services as described earlier. Strategic business alliances are being forged to reinforce the Company's process engineering and marketing capabilities. BV SORBEX, Inc. plans to enter European markets early as well as those of India, Japan, South America and China in that order of priority. Steps and representations have already been made in that direction establishing direct links and partnerships.

**REMOVAL/RECOVERY OF METALS
FROM INDUSTRIAL SOLUTIONS AND WASTEWATERS
BY NEW BIOSORBENT MATERIALS**

THE COMPANY GROWTH

4 STAGES

OUTLINE OF THE COMMERCIAL VENTURE

Original research work by Professor Volesky at McGill University in Montreal has led to significant discoveries involving the use of non-living microbial biomass. Several patents resulted from these efforts which provide a basis for a new family of products called BIOSORBENTS. These biosorbent materials can be used just like ion exchange resins or activated carbon in removal of heavy metals from dilute solutions. At this point it should be stressed that some biosorbents in certain applications outperform commercial ion exchange resins or activated carbons currently used in metal recovery processes and wastewater purification applications. Biosorbents bind and concentrate heavy and precious metals, sometimes very selectively, when contacted with metal-bearing solutions either in mixed tanks, fixed bed or fluidized bed flow-through columns. When saturated with deposited metals, the biosorbent granules are washed, releasing the metal in high concentrations. Following this regeneration they can be used many times over again in repeated operation cycles improving thus significantly the overall economy of the process.

Heavy metallic elements are toxic and discharge of metal containing industrial solutions or wastewaters poses an environmental hazard. The application of cheap biosorbents in detoxification of industrial wastewaters will make their treatment economically feasible. Metals of value can even be recovered this way for reuse or resale. The application potential of the new metal removal/recovery biosorption technology is very broad and the projected low price of the new biosorbents is likely to make them extremely competitive. They are produced from waste microbial biomass rejected by large-scale fermentation operations. Algal biomass for certain types of biosorbents can be collected in large quantities from the oceans.

In order to bring the new biosorbent technology to its full commercial potential, the newly formed company, BV SORBEX, Inc., plans to do so in several venture *development stages* enabling the reassessment of the enterprise after each stage and allowing good control of the growth of the Company. The first two stages of the venture development process cannot be expected to produce any financial return. The third stage should see the beginning of the client-Company interaction and contract-based cash flow. Following the venture consolidation, refinancing and manufacturing plant start-up investments, *Stage 4* should start generating a *positive cash flow*. In the following briefs the summary of individual stages for the development of this commercial venture based on new biosorbent technology are outlined.

Outline of Commercial Venture: EXECUTIVE SUMMARY

STAGE 1

FEASIBILITY OF THE BIOSORPTION VENTURE

A considerable amount of research on biosorbent materials has developed a solid basis of knowledge and indicated their enormous potential. The highest priority at this stage is the preliminary and approximate assessment of the commercial potential and feasibility of application of the new technology based on the family of new biosorbent products. Correspondingly, STAGE 1 consists of two basic studies:

A) ASSESSMENT OF THE COMPETING TECHNOLOGIES

The current costs and market share of the established conventional processes for metal removal/recovery from dilute solutions or wastewaters have to be summarized and assessed. Similarly for new unconventional and even new biosorbent-based processes which are approaching the stage of application in the field.

B) ASSESSMENT OF THE MARKET SIZE

While it is known that the environmentally-based market for metal removal/detoxification of metal-containing (industrial) effluents is enormous, the actual figures to support this generally prevailing perception would be most convincing although not essential for launching the Company enterprise. A quantitative review of the potential clientele is to be carried out for different countries where the Company may consider operating its processes.

Comparison of costs between the conventional and the new technology establish the feasibility of biosorbent applications and their competitiveness in the market place. As the application of biosorbent technology proves cheaper and more competitive it is anticipated that new applications will significantly increase the size of the current market.

STAGE 1 has been practically completed resulting in 2 thorough *studies* summarized in comprehensive *Reports*. Participation of independent consultants for impartial conclusions was secured.

Findings most encouraging for the enterprise are reflected in the Company Business Plan.

ASSESSMENT OF NEW BIOSORBENTS COSTS

At this point it is not known what exactly would be the real production costs of new biosorbent materials processed into suitably applicable granules. Approximate costs of different types of raw biomass need to be ascertained, as well as the costs of processing the biomass into applicable biosorbent materials maintaining their high sorption efficiency.

STAGE 2 will require:

Travel and fact finding efforts necessary to reliably establish the exact costs and conditions under which waste industrial biomass can be obtained from the large-size industrial operators.

Similarly for the price of ocean-based biomass of selected marine algae which has to be collected from high seas or offshore areas.

Estimation of the costs of preprocessing and drying the raw biomass to prevent its degradation will have to be carried out for selected representative types of biomass available in large quantities.

Preliminary technical work to be carried out on the processing necessary for biomass formulation into a biosorbent product suitable for process uses. It is anticipated that different raw biomass materials (algae, fungi, bacteria) will require different and specific treatment for their optimal formulation into finished ready-to-use products. This part will entail specifically planned small-scale laboratory work and preliminary optimization of the procedures involved resulting in an efficient biosorbent material.

THE OVERALL OBJECTIVE:

Reliable estimate of the biosorbent production costs for selected representative biosorbent materials.

Ideally, **STAGE 2** could be carried out simultaneously with **STAGE 1** as part of a better quantitative venture feasibility assessment.

However, it could also become part of the following scaled-up pilot-plant effort planned as **STAGE 3**.

The budget for STAGE 2 has been estimated at US\$ 300,000 for approximately a 6 month period

**FORMULATION OF BIOSORBENT MATERIALS
AND CLIENT-BASED FIELD TESTS**

Positive conclusion on the feasibility of a commercial biosorbent technology venture based on *STAGES 1* and *2* would be ideally a basic "go-ahead" for *STAGE 3*. The spectrum of biosorbent materials for different applications has to be technologically formulated for optimal production and use. This involves:

- establishment of the raw biomass materials supply;
- optimization of the biomass processing technology;
- optimization of the biosorbent granule properties;
- optimization of the biosorbent application mode;
- selection of clients for cooperative tests.

This line of work is expected to be highly technical and laboratory based, requiring skilled manpower. The result:

- selected biosorbents available in (kg) quantities;
- small biosorbent production unit;
- small pilot plant (mobile) application equipment;
- a line of industrial clients identified.

Planning of *STAGE 3* is summarized in a detail proposal which can be modified to suit the circumstances of the agreed-upon Company financing. This stage of work is not considered to be carried out as a Company in-house activity. For a better efficiency at this stage, a suitable arrangement may be negotiated utilizing the existing expertise and equipment at McGill University in Montreal and/or the Company partners.

STAGE 3 budget is estimated at an approximate total of up to US\$ 3,000,000 over a period of no more than 2 years.

It is based on a team of probably 4 technical professionals, supporting staff, (pilot) equipment manufacturing and assembly costs, supply materials, travel expenses and an appropriate overhead.

Outline of Commercial Venture:

EXECUTIVE SUMMARY

STAGE 4**FULLY COMMERCIAL BIOSORBENT ENTERPRISE**

Based on the findings of *STAGE 1* reviews it can be realistically envisioned that the biosorbent technology is well poised for penetrating the market for metal removal and recovery from industrial solutions. The Company development stages have been designed to develop a solid basis for the full-scale commercialization of the new technological venture.

A well organized corporate structure, scaled-up production facilities, and engineering services supporting the application of the new technology are the goal of the totally re-financed and restructured Company in *STAGE 4* which should see:

- securing of raw material supplies
- scaled-up biosorbent processing facility
- marketing strategy for the product lines
- line-up of potential clients (from *STAGE 3*)
- alternative contract schemes for technology application
- further innovative R&D on new products and applications of biosorbents.

Consolidation of the Company and its own production facilities, as well as R&D activities will have to take place early in *STAGE 4*.

Aggressive marketing of the product lines, of the technology, and eventually of the whole service package arrangements including the marketing of or profit sharing on the recovered metals will be essential at this stage. Solid corporate strategies will have to be developed in this respect to back dynamic sales efforts.

This restructuring of the Company and consolidation of its own R&D as well as its scaled-up production facilities will require a certain infusion of capital in another phase of Company restructuring (as yet unspecified at this planning stage). Appropriate negotiations will be initiated in time for developing the most suitable consolidation scheme.

STAGE 4, after 2 to 3 years of initial investments in STAGES 1, 2, and 3, should start generating net return on investment with an attractive profit margin based on the innovative nature of the Company business and new market opportunities being gradually opened.

***STAGE 4* represents an open-ended business operation with a steadily increasing cash flow and a healthy operating profit margin. By this time the equity of the original investors in the Company represents an exciting return on the original investment.**

Commercial Venture:

Where is BV SORBEX ?

THE SUMMARY OF THE BIOSORPTION VENTURE SITUATION

- 1) The know-how for the metal biosorption technology resides with BV SORBEX, Inc. which is an upstart Montreal (Canada) based privately owned enterprise.
- 2) Most of the R&D advances have been made in McGill University laboratories.
- 3) For very practical reasons it may be advisable to support the pilots from the University or local government laboratories.
- 4) The technology is ready to go “demonstration pilots” with 2-3 well selected industrial sector clients.
Mining and electroplating industries and/or arsenic water decontamination have been singled out as priority targets.
- 5) The piloting operations will require approximately :
2 YEARS and the grand total of roughly US\$ 2.5 million.
- 6) This investment could be:
 - supplied in STAGES enabling better progress control;
 - provided by one investor (for better control) or by several parties (an appropriate control sharing has to be agreed upon).
- 7) The initial guaranteed start-up financing should be in the order of **US\$ 400,000**, to be extended based upon satisfactory progress.
- 8) The pilot stage will:
 - demonstrate the feasibility and scale-up of the process;
 - explore the market and line up further clients.
- 9) Following the pilot stage, a **RESTRUCTURING** (Stage 4) of the venture is anticipated to secure operating capital:
 - establishing client consulting activities (providing cash-flow);
 - government participation schemes (grants, tax credits);
 - further guarantees of private and/or corporate placement (?);
 - going public (IPO) to secure operating capital (?).

There are many possible ways of “skinning the cat” – of setting up the partnership(s) in this venture. What remains to be specifically negotiated:

- the ownership and control of the technology venture enterprise;
- the exclusivity of the technology operation and licensing considerations;
- the participation of additional partners,
(contributing engineering, sales and/or financial component(s) ...)

Technically, the **technology is sound and working**. No major technical obstacles are foreseen, process scale-up is known and NOT considered a problem, driving environmental pressures are steadily mounting. As expected, the “**sales**” are the most sensitive aspects. The art of “**deal-making**” is crucial for formulating a reliable venture enterprise infrastructure.

