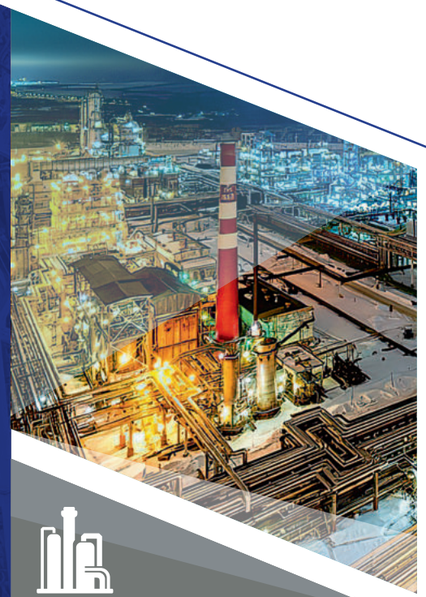
SKTB KATALIZATOR



OIL & GAS REFINING

SULFUR REMOVAL

PETROCHEMICAL INDUSTRY

INDUSTRIAL ECOLOGY

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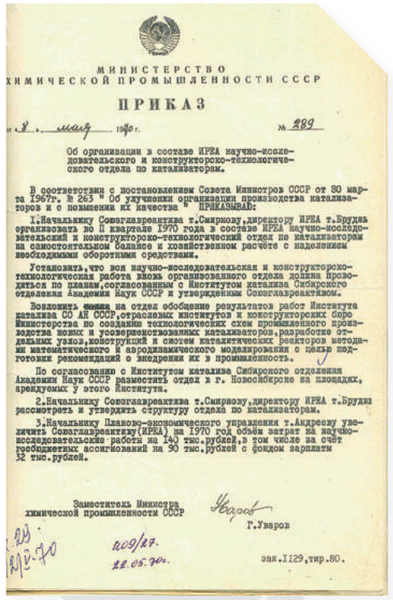
ABOUT US

SKTB Katalizator is a top Russian developer, manufacturer and supplier of catalytic technologies, products and services for refining, petrochemicals, industrial ecology and sulfur removal. The company develops and manufactures catalysts, sorbents and catalyst carriers, and offers engineering services.

HISTORY

In 1970, SKTB Katalizator was established in Novosibirsk Akademgorodok at the initiative of Academician G.K. Boreskov to strengthen collaboration between academic science and industry.



МИНИСТЕРСТВО
ХИМИЧЕСКОЙ ПРОМЫШЛЕННОСТИ СССР

ПРИКАЗ

3 мая 1970 г. № 289

Об организации в составе НИИА научно-исследовательского и конструкторско-технологического отдела по катализаторам.

В соответствии с постановлением Совета Министров СССР от 30 марта 1967г. № 263 " Об улучшении организации производства катализаторов и о повышении их качества " ПРИКАЗЫВАЮ:

1.Начальнику Совхимуправления т.Смирнову,директору НИИА т.Брудзю организовать во II квартале 1970 года в составе НИИА научно-исследовательский и конструкторско-технологический отдел по катализаторам на самостоятельном балансе и хозрасчетном расчете с наделением необходимыми оборотными средствами.

Установить,что вся научно-исследовательская и конструкторско-технологическая работа вновь организованного отдела должна производиться по планам,согласованным с Институтом катализа Сибирского отделения Академии наук СССР и утвержденным Совхимуправлением.

Возложить оценку на отдел обобщение результатов работ Института катализа СО АН СССР,отраслевых институтов и конструкторских бюро Министерства по созданию технологических схем промышленного производства новых и усовершенствованных катализаторов,разработке отдельных узлов,конструкций и систем каталитических реакторов методами математического и аэродинамического моделирования с целью подготовки рекомендаций о внедрении их в промышленность.

По согласованию с Институтом катализа Сибирского отделения Академии Наук СССР разместить отдел в г. Новосибирске на площадях, арендуемых у этого Института.

2.Начальнику Совхимуправления т.Смирнову,директору НИИА т.Брудзю рассмотреть и утвердить структуру отдела по катализаторам.

3.Начальнику Планово-экономического управления т.Андрееву увеличить Совхимуправлению(НИИА) на 1970 год объём затрат на научно-исследовательские работы на 140 тыс.рублей,в том числе за счет госбюджетных ассигнований на 90 тыс.рублей с фондом зарплаты 32 тыс.рублей.

Заместитель Министра химической промышленности СССР Г.Уваров

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COMPANY TODAY

SKTB Katalizator employees are high-qualified catalytic process experts. The company has innovative manufacturing, R&D and engineering capabilities with R&D Center in Novosibirsk and production sites in 3 Russian regions.

ABOUT

- **OVER 18,000 TONS OF PRODUCTS EACH YEAR**
- **5 MANUFACTURING SITES**
- **OVER 550 EMPLOYEES**

PROMKATALIZ (Industrial Catalysts) JSC
Location: Ryazan
Manufacturing site
QC laboratory

KHIMSINTEZ JSC
Location: Novosibirsk
Production of rare and rare-earth metal salts and high-purity gases
QC laboratory

SKTB KATALIZATOR JSC
Location: Novosibirsk (Headquarters)
Manufacturing site
R&D Center

Achinsk branch
Manufacturing site
QC laboratory

Linevo branch
Manufacturing site
Logistics hub

SECTOR

AOK-78-52

OZONE DESTRUCTION CATALYST

APPLICATION

Applied for residual ozone decomposition. The catalyst is used in industrial gas treatment units.

BENEFITS

- Removal efficiency up to 99%
- High activity at low temperature

ENGINEERING SERVICES

- ✓ Supervision of catalyst loading and unloading
- ✓ Support of the startup and commissioning of gas treatment units
- ✓ Monitoring catalyst performance during operation
- ✓ Measuring physicochemical properties and performance of the catalyst sampled during the operation cycle

PHYSICOCHEMICAL PROPERTIES

Parameter	AOK-78-52	
	Grade A	Grade B
Shape	cylinders	
Color	black	
Length, mm	7.5±2.5	
Diameter, mm	4.0±0.5	
Bulk density, g/cm^3	1.60±0.25	1.50±0.15
Surface area, m^2/g	≥20	
Crush strength, MPa	≥2	

AOK-75-52 A

CATALYST FOR LOW TEMPERATURE OXIDATION OF VOC AND/OR CO

APPLICATION

The catalyst is applied for gas emission treatment at chemical, petrochemical, and metal plants. AOK-75-52 A is specifically designed for VOC (volatile organic compounds) low-temperature oxidation and/or CO (carbon monoxide). The catalyst can be also used for ozone decomposition. AOK-75-52 A is manufactured at SKTB Katalizator JSC facilities by the proprietary process. The catalyst is produced as cylindrical extrudates; optionally rings, spheres, or quadralobes are available.
The variety of catalyst shapes allows you to select the optimal load in terms of removal efficiency and hydraulic resistance.

BENEFITS

- Removal efficiency up to 99%
- High catalytic activity in the medium temperature range (200–550°C)
- Resistance to short-term effects of high temperature
- Resistance to sulfur compounds
- The catalyst is precious metal-free

PHYSICOCHEMICAL PROPERTIES

Catalyst Geometry	Size	Mechanical strength, min	Bulk density, g/cm^3	Surface area, m^2/g, min
Cylinder	diameter: 2-4 mm	2.5 MPa	0.85–0.95	100
Quadralobe	circumscribed-circle diameter: 2-4 mm	10 N/mm	0.80–0.90	100
Ring	outer diameter: 13-17 mm, wall thickness: 3.0-3.4 mm	4 N/mm	0.70–0.80	100
Sphere	diameter: 2-5 mm	4 MPa	0.75–0.85	100

ICT-12-8

CATALYST FOR MEDIUM TEMPERATURE OXIDATION OF VOC AND/OR CO

APPLICATION

Catalyst is intended for VOC (volatile organic compounds) and/or CO.
ICT 12-8 is used in petrochemical, paint-and-lacquer and polymer industries. The catalyst has been operated in Russia, the USA, Belgium and Italy.

BENEFITS

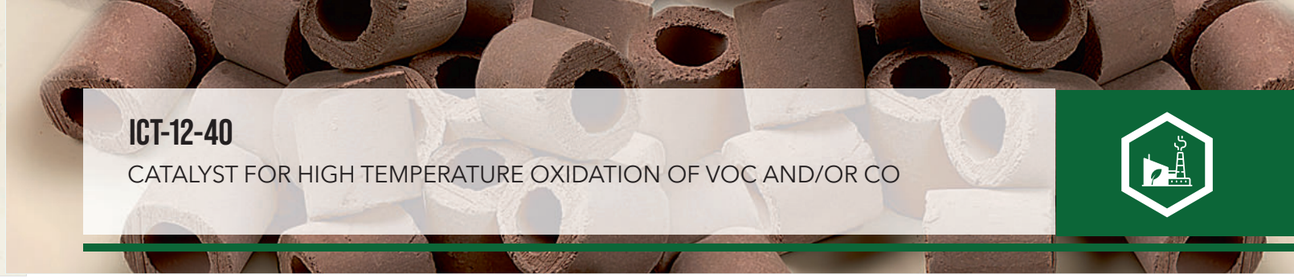
- Removal efficiency up to 99%
- High catalytic activity in the medium temperature range (350–700°C)
- Resistance to short-term effects of high temperature
- Resistance to sulfur compounds
- The catalyst is precious metal-free

ENGINEERING SERVICES

- ✓ Supervision of catalyst loading and unloading
- ✓ Support of the startup and commissioning of gas treatment unit
- ✓ Monitoring catalyst performance during operation
- ✓ Measuring physicochemical properties and performance of the catalyst sampled during the operation cycle

PHYSICOCHEMICAL PROPERTIES

Parameter	ICT-12-8	
	Grade A	Grade B
Shape	cylinders	rings
Color	black, greenish shade is allowed	
Length, mm	15±10	15±3
Outer diameter, mm	4.5±1.5	15±2
Wall thickness, mm	–	3.5±0.5
Bulk density, g/cm^3	0.8±0.2	0.65±0.15
Surface area, m^2/g	≥70	
Crush strength	≥2.0 MPa	≥3.0 N/mm



ICT-12-40

CATALYST FOR HIGH TEMPERATURE OXIDATION OF VOC AND/OR CO

APPLICATION

Catalyst is intended for CO and VOC oxidation. Applied for emission treatment in petrochemical, wood, polymer and varnish & paint industries. ICT-12-40 has been operated in plants in the USA.

BENEFITS

- Removal efficiency up to 99.9%
- High catalytic activity in the temperature range up to 700°C
- Resistance to short-term effects of temperatures up to 1000°C without loss of activity and crush strength
- Resistance to catalytic poisons, including chlorine-, fluorine-containing compounds
- The catalyst is precious metal-free

ENGINEERING SERVICES

- ✓ Supervision of catalyst loading and unloading
- ✓ Support of startup and commissioning of gas treatment units
- ✓ Monitoring catalyst performance during-operation
- ✓ Measuring physicochemical properties and performance of the catalyst sampled during the operation cycle

PHYSICOCHEMICAL PROPERTIES

Parameter	ICT-12-40		
	AM-1	AM-2	AM-4
Shape	rings		cylinders
Color	brown, grade shade is allowed		
Length, mm	10±2	15±3	15±10
Outer diameter, mm	10±2	15±2	4.0±1.5
Wall thickness, mm	3.0±0.5	3.5±0.5	–
Bulk density, g/cm^3	0.70±0.15		0.9±0.2
Crush strength	≥3.0 N/mm		≥2.5 MPa

AOK-75-41

CATALYST FOR CO AND VOC OXIDATION

APPLICATION

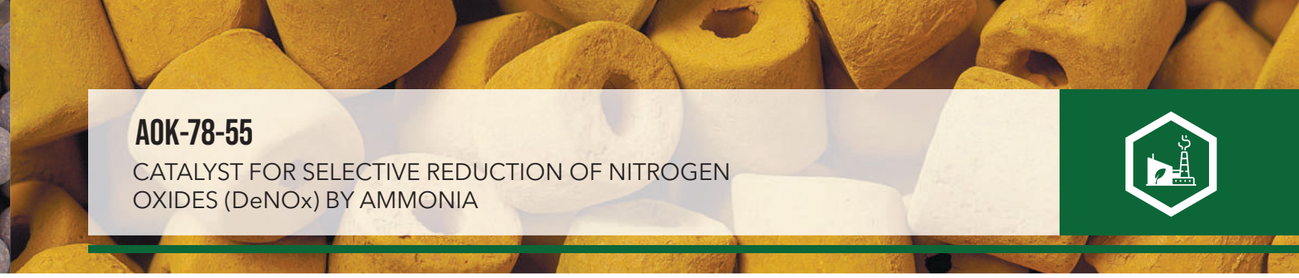
Catalyst is intended for CO and VOC oxidation. Applied for emission treatment in petrochemical, wood, polymer and varnish & paint industries.

BENEFITS

- Removal efficiency up to 99.9%
- High catalytic activity in the temperature range up to 700°C
- Resistance to short-term effects of temperatures up to 1000°C without loss of activity and crush strength
- Resistance to catalytic poisons, including chlorine-, fluorine-containing compounds
- The catalyst is precious metal-free

PHYSICOCHEMICAL PROPERTIES

Parameter	AOK-75-41	
	Grade A	Grade B
Shape	spheres	
Color	brown with different shades	
Diameter, mm	2.5–3.5	3.0–5.0
Bulk density, g/cm^3	1.0±0.15	1.0±0.2
Attrition resistance: catalyst fines wt.% after 240 minutes attrition	≤0.3	–



AOK-78-55

CATALYST FOR SELECTIVE REDUCTION OF NITROGEN OXIDES (DeNOx) BY AMMONIA

APPLICATION

Catalyst is intended for nitrogen oxides (NO_x) removal from offgases and tail gases in fertilizer and nitric acid manufacturing. AOK-78-55 is supplied to nitrogen manufacturers.

BENEFITS

- High DeNOx efficiency: min 97%
- High catalytic activity in the temperature range of 220-340°C
- Applied for NOx removal from gas stream with min concentration of 0.01%
- High crush strength prevents the entrainment of the active component

ENGINEERING SERVICES

- ✓ Supervision of catalyst loading and unloading
- ✓ Support of startup and commissioning of gas treatment units
- ✓ Development of customized instructions for safe catalyst operation
- ✓ Monitoring catalyst performance during operation
- ✓ Measuring physicochemical properties and performance of the catalyst sampled during the operation cycle

PHYSICOCHEMICAL PROPERTIES

Parameter	AOK-78-55	AOK-78-55 M	AOK-78-55 K	AOK-78-55 KM
Shape	cylinders		rings	
Color	yellow/yellow-green			
Length, mm	≤18		5–10	
Diameter, mm	5±1		6.5–8.5 (outer)	
	–		2 (inside, min)	
Bulk density, g/cm^3	0.7–0.9			
Mechanical strength: loss on attrition, %	≤2.0			

AOK-75-50 (Z-10)

VOC AND CO CATALYTIC OXIDATION

APPLICATION

The AOK-75-50 catalyst is used to replace random honeycomb heat exchange packing in regenerative thermal oxidizers (RTO) operating in reverse mode. The catalyst is also applied in the fixed-bed of once-through catalytic and thermocatalytic oxidation reactors.

Reactions of complete (deep) oxidation of volatile organic compounds, carbon monoxide and methane proceed with heat release and formation of the following products:

$C_xH_yO_z + O_2 = CO_2 + H_2O$

The variety of shapes of alumina manganese catalysts allows you to select the optimal catalyst loading in terms of removal efficiency and bed hydraulic resistance.

Alumina manganese oxide catalyst is designed for emission treatment of enterprises processing wood and producing slab materials (chipboard, plywood), as well as various chemical industries. Catalyst AOK-75-50 ensures activity in complete oxidation of CO, organic compounds (VOC) and methane (CH_4).

The catalyst pellet has a honeycomb structure to increase the fractional free volume and efficiency of the catalyst surface area. Honeycomb alumina manganese oxide catalysts are developed and produced.

ENGINEERING SERVICES

- ✓ Calculation of the loading and characteristics of the catalyst bed
- ✓ Supervision of catalyst loading
- ✓ Monitoring catalyst performance duringoperation
- ✓ Measuring physicochemical properties and performance of the catalyst sampled during the operation cycle
- ✓ Development of engineering solutions over AOK-75-50 (Design Basis) and author's supervision

BENEFITS

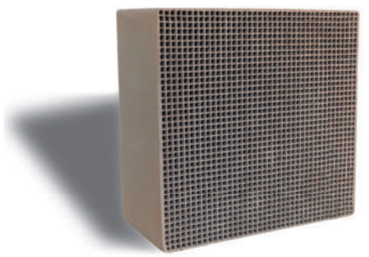
- High VOC and CO removal efficiency for gas emissions – up to 99%
- Improved efficiency due to low hydraulic resistance vs ring-shaped catalyst
- High catalytic activity in the temperature range of 500–700°C
- Long catalyst life due to the stable active component and high mechanical strength
- High resistance to short-term temperature effects up to 900°C without loss of activity and mechanical strength
- Low operating costs for the catalyst due to platinum- and palladium-free composition
- High crush strength prevents the destruction of granules and pressure drop increase in the bed
- Manufactured in Russia using proprietary technologies

CO AND VOC OXIDATION CATALYSTS

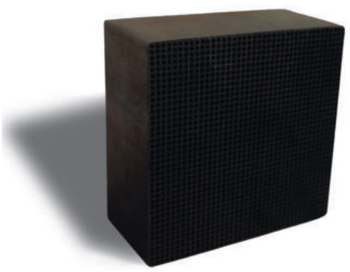
AOK-75-6X SERIES MONOLITH CATALYSTS

APPLICATION

SKTB Katalizator JSC has developed 2 new types of monoliths: AOK-75-60 high-temperature catalyst and AOK-75-64 low-temperature catalyst. Both catalysts show high activity and are precious metal free.



AOK-75-60

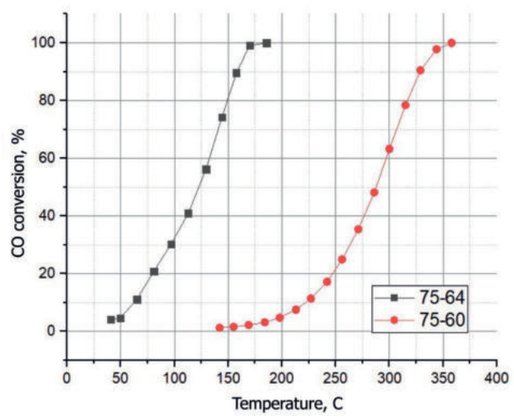


AOK-75-64

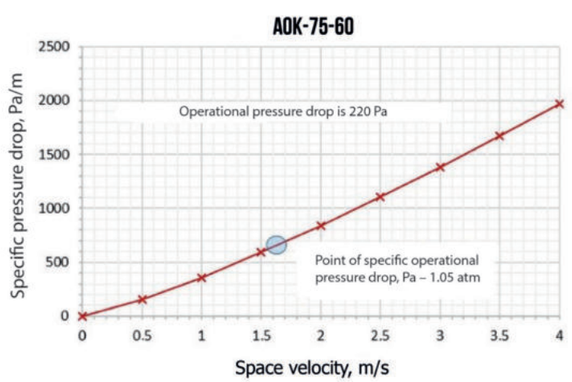
PHYSICOCHEMICAL PROPERTIES

Parameter	Catalyst	
	AOK-75-60	AOK-75-64
Density, g/cm^3	0.78	0.88
Max operating temperature, °C	850	550
Activity by C_4H_9 oxidation, cm^3/g*s	(4.0±0.5)*10^{-2}	(4.5±0.5)*10^{-2}

The diagram below shows the data for CO oxidation (space velocity 10 000 h^{-1}, 6% O_2, flow reactor):



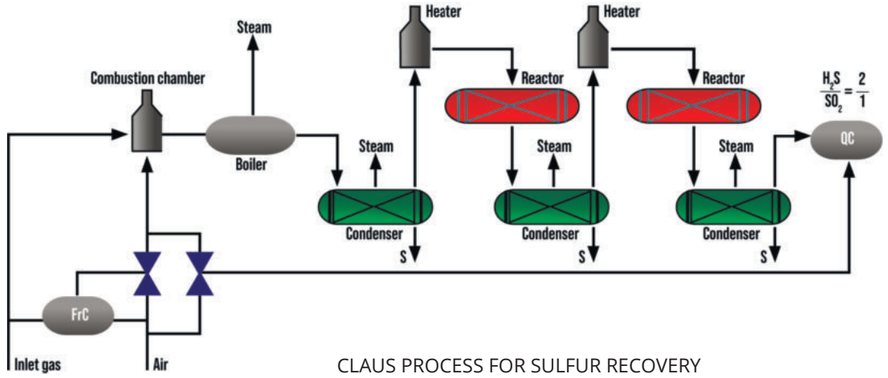
The diagram below shows the pressure drop for 75-6x series in the temperature range of 200-400°C:



APPLICATION

Catalysts are applied at Claus sulfur recovery units for hydrogen sulfide removal from natural and industrial gases of diverse origin. Catalysts provide high activity in the main Claus reaction, as well as in conversion of sulfur-containing compounds (carbonyl sulfide and carbon disulfide).

$$2H_2S + SO_2 \rightarrow {}^3/_nS_n + 2H_2O$$
$$COS + H_2O \rightarrow H_2S + CO_2$$
$$CS_2 + 2H_2O \rightarrow 2H_2S + CO_2$$



CLAUS PROCESS FOR SULFUR RECOVERY

PORTFOLIO OF CLAUS CATALYSTS

SKTB Katalyzator JSC manufactures a range of catalysts for the Claus process using its proprietary technologies. Combining several catalysts ensures optimal price and quality (the required removal efficiency).

Brand name	Application
AOK-78-59	Alumina sphere-shaped Claus catalyst
AOK-78-61	Claus alumina sphere-shaped catalyst used as active bed support (large pellet diameter > 8 mm)
AOK-75-33	Claus alumina sphere-shaped oxygen scavenger
AOK-75-46 D	Claus titanium dioxide composite catalyst with improved porous structure and increased efficient lifetime (titanium dioxide content 75±5%)
AOK-75-44	Catalyst for Claus tail gas treatment for H_2S selective oxidation to sulfur
AOK-75-48	Catalyst for Claus tail gas treatment during the reduction of sulfur compounds to hydrogen sulfide

AOK-78-59, AOK-78-61, AOK-75-33

CLAUS ALUMINA CATALYSTS

APPLICATION

Catalysts are applied for H_2S removal from natural and industrial gases in refining, petrochemicals, gas plants and metal plants.

BENEFITS

- High resistance to thermal and hydrothermal aging
- High resistance to HC poisoning
- Closely graded catalysts ensure low level hydrodynamic resistance inside the commercial-scale reactor
- Competitive physicochemical properties and catalytic performance compared to advanced commercial counterparts

ENGINEERING SERVICES

- ✓ SRU performance analysis
- ✓ Calculation of H_2S conversion rate for thermal and catalytic stages
- ✓ Providing recommendations on optimal plant operating conditions
- ✓ Tailoring optimal catalyst loading
- ✓ Investigation on physicochemical properties and performance of the fresh and spent catalysts
- ✓ Supervision of catalyst loading
- ✓ SRU performance lifetime monitoring

PHYSICOCHEMICAL PROPERTIES

Parameter	AOK-78-59 Conventional Claus catalyst	AOK-78-61 Support layer catalyst	AOK-75-33 Oxygen Scavenger (Sulfation Guard)
Shape	spheres		
Color	white		yellow-brown
Diameter, mm	3-8	8–15	4–6
Bulk density, g/cm^3	0.70–0.75		0.75–0.78
Surface area, m^2/g	≥300	≥280	≥250
Pore volume , ml/g	≥0.5		≥0.45
Crush strength, MPa	≥5	≥4.5	≥5
Composition	alumina		Fe-promoted alumina

AOK-75-46

CLAUS TITANIUM DIOXIDE-BASED CATALYST

APPLICATION

Catalysts are applied for H_2S removal from natural and industrial gases in refining, petrochemicals, gas plants and metalmanufacturing.

BENEFITS

- High conversion of COS/CS_2 in the temperature range of 260–350°C
- Improved surface area and strength
- Optimal porous structure
- High resistance to sulfation and HC poisoning
- High resistance to hydrothermal aging up to 450°C
- Can be used in acid gas treatment by direct oxidation of hydrogen sulfide to sulfur

ENGINEERING SERVICES

- ✓ SRU performance analysis
- ✓ Calculation of H_2S conversion rate for thermal and catalytic stages
- ✓ Providing recommendations on optimal unit operating conditions
- ✓ Tailoring optimal catalyst loading
- ✓ Investigation of physicochemical and catalytic performance of the fresh and spent catalysts
- ✓ Supervision of catalyst loading
- ✓ SRU operation lifetime monitoring

PHYSICOCHEMICAL PROPERTIES

Parameter	AOK-75-46
Shape	cylinders
Color	white
Diameter, mm	2.5-4.5
Surface area, m^2/g	≥150
Crush strength, MPa	≥3.5
Content of Ti (IV) oxide, wt.%	75±5

AOK-75-44 M

CATALYST FOR H_2S SELECTIVE OXIDATION TO SULFUR

APPLICATION

Catalyst is intended for H_2S removal from gases of diverse origin with H_2S content from 0.3 vol.% to 15 vol.% in oil & gas industry, refining and metal manufacturing. Technologies over AOK-75-44 M catalyst are used for Claus tail-gas treatment. The catalyst can be used for treating low-sulfur natural gases, APG, chemical industry emissions and biogas.

Gas treatment over AOK-75-44 M catalyst is based on the reaction of H_2S selective oxidation to sulfur:

$H_2S + {}^1/_2O_2 = 1/nS_n + H_2O$,

at temperatures 200–280°C.

One-stage treatment of gases with H_2S content <2 vol.% is possible in the fixed-bed catalytic reactor.
Gases with H_2S content <2 vol.% can be treated in reactors in-series or in one multiple-section reactor with batch oxygen feeding to each reactor.

BENEFITS

- High catalytic activity and selectivity in the temperature range of 220–300°C
- High resistance to hydrothermal aging
- Low sensitivity to excess oxygen and water vapor content in the processed gas
- Non-reactivity towards HC, CO and hydrogen oxidation
- High operation stability during 3-4 years of service

PHYSICOCHEMICAL PROPERTIES

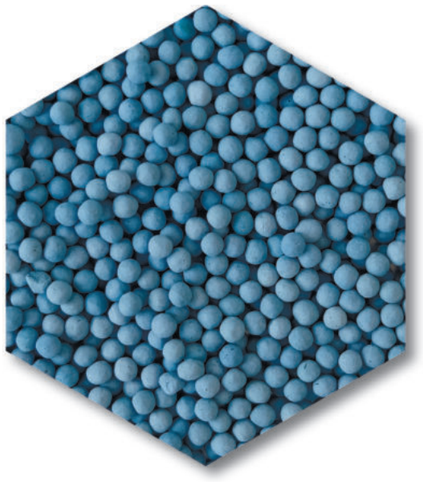
Parameter	AOK-75-44 M
Shape	cylinders
Color	reddish brown
Diameter, mm	4–6
Surface area, m^2/g	≥4
Crush strength, MPa	≥4
Bulk density, g/cm^3	1.2–1.5

AOK-75-48

CATALYST FOR CLAUS TAIL-GAS TREATMENT

APPLICATION

The catalyst is designed to reduce and hydrolyze sulfur compounds to hydrogen sulfide in Claus offgases, ensuring a total sulfur recovery rate of 99.5-99.9% at the plant.
The AOK-75-48 catalyst is applied for treating Claus offgas at oil and gas refineries. In this process, all sulfur compounds (SO_2, COS, CS_2, sulfur vapor and droplets) are reduced to hydrogen sulfide (H_2S).
The catalyst is manufactured by the proprietary process.



ENGINEERING SERVICES

- ✓ Plant performance analysis
- ✓ Providing recommendations on optimal plant operating conditions
- ✓ Tailoring optimal catalyst type and pellet geometry
- ✓ Investigation on physicochemical and catalytic performance of the fresh and spent catalysts
- ✓ Supervision of catalyst loading
- ✓ Plant operation lifetime monitoring

BENEFITS

- The catalyst's properties are comparable to well-known world counterparts for Claus tail gas treatment, using the reduction/ hydrolysis of sulfur compounds to hydrogen sulfide.
- Three catalyst types are available for different operating temperature ranges: low temperature from 200 to 240°C, medium temperature from 240 to 280°C, high temperature from 280 to 350°C.
- High activity across the entire temperature range in COS/CS_2 hydrolysis reactions
- High resistance to thermal and hydrothermal aging in a reaction environment containing water vapor
- The catalyst is produced as spheres and cylindrical extrudates

IC-12-72

SPHERE-SHAPED CATALYST FOR FLUIDIZED-BED OXIDATION OF HYDROGEN SULFIDE AD ORGANIC SUBSTANCES

APPLICATION

A catalyst for the selective oxidation of hydrogen sulfide to sulfur in a fluidized bed is applied in acid gas removal unit for APG treatment.
Also used for combustion of various types of fuel in catalytic heat generators and combustion of organic components of salt-free wastewater and other mixed organic wastes.

BENEFITS

- High activity in oxidation of organic compounds and hydrogen sulfide
- Stability during long-term operation
- High mechanical strength
- Improved chemical composition
- High thermal stability (up to 700°C)
- High resistance to sulfur poisoning

PHYSICOCHEMICAL PROPERTIES

Parameter	IC-12-72
Shape	sphere
Color	dark-green (willow green)
Diameter, mm	1.4–2.0
Target fraction, wt.%, min	85
Bulk density, g/cm^3	0.8–1.2
Surface area, m^2/g, min	80
Crush strength, average, N/pellet, min	30

AOK-72-55

CATALYST FOR LOW-TEMPERATURE ISOMERIZATION
OF LIGHT NAPHTHA (C5-C6)

APPLICATION

Platinum-based catalyst for light naphtha isomerization is applied in refining for production of Euro-5 fuels. AOK-72-55 catalyst allows increasing the octane rating from 63-68 to 91-92 RON.

AOK-72-55 is based on a sulfated zirconia to provide the target acidity and distribution of the active component. The catalyst features high stability of operation and extended lifetime (8–12 years).

AOK-72-55 is available in the form of cylindrical extrudates.

AOK-72-55 catalyst is used as a fixed bed in one-, two- and three-reactor circuits of isomerization units. The catalyst can be operated most effectively in isomerization recycle plants.

AOK-72-55 catalyst is operated within low-temperature range (130–180°C) and is more advantageous for naphthenic ring-opening, providing higher isomerization recycle plant performance. AOK-72-55 is also effective for benzene removal.

AOK-72-55 can be used as alternative to chlorinated and zeolite isomerization catalysts. Moreover, the switching from a chlorinated isomerization catalyst to a zirconium sulfate catalyst does not require a major modification in the plant process flow or the purchase of extra equipment.

ENGINEERING SERVICES

- ✓ Process audit of existing commercial isomerization units; issuing recommendations on performance improvement
- ✓ Development of process operating procedures for unit operation
- ✓ Pre-production technical assistance (pre-commissioning, catalyst loading and activation), supervision during startup and commissioning
- ✓ Monitoring of the isomerization unit operation
- ✓ Development of technical reports on operation of the process units with issuing the recommendations on further effective operation

BENEFITS

- Competing activity and conversion degree of normal paraffins compared to world counterparts
- Injection of a chloriding agent is not required to maintain catalyst activity
- Resistance to slips of sulfur, nitrogen and water that do not result in irreversible loss of activity
- Operates at low H_2/HC molar ratio of 0.15:1
- Capability to regenerate the catalyst without loss of activity
- Manufactured in Russia using proprietary technologies

AOK-77-56

CATALYST FOR HYDROTREATED NAPHTHA REFORMING IN A FLUIDIZED BED

APPLICATION

Catalyst is manufactured using proprietary process and Is intended to improve naphtha octane rating and produce C6–C9 hydrocarbons.
AOK-77-56 is available in shape of spheres with D 1.6–1.8 mm and 1.8-2.0 mm. Platinum-tin catalyst.

Catalyst is designed for CCR (continuous catalyst regeneration) reformers (moving-bed units).

ENGINEERING SERVICES

- ✓ Catalyst testing with the Customer's feedstock at our lab-scale catalytic units. A catalyst sample can be provided to the Customer for testing in the Customer's laboratory

AOK-77-25

CATALYST FOR HYDROTREATING OIL FRACTIONS

APPLICATION

Catalyst is designed to remove sulfur, nitrogen, and oxygen compounds from oil fractions. AOK-77-25 is applied in refineries to produce motor fuels from medium distillates. AOK-77-25 catalyst ensures the ultra-low sulfur content in the fuel (less than 10 ppm).

The catalyst is available in the shape of trilobe extrudates with D 2-3 mm. Also available in quadralobes. The catalyst contains a cobalt-molybdenum component.

BENEFITS

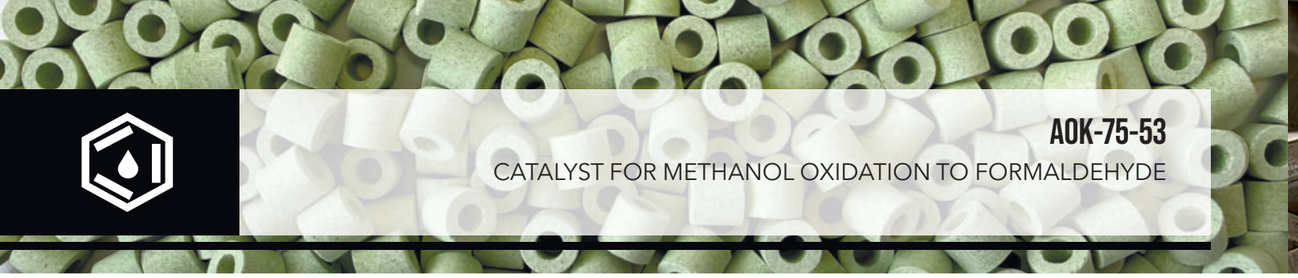
- Hydrodesulfurization and denitrogenation capacity highly competitive to the worldbest counterparts
- High concentration of the active component (up to 23 wt.% molybdenum trioxide)
- The catalyst can be used after regeneration
- High mechanical strength
- Manufactured in Russia using proprietary technologies

APPLICATION

AOK-77-25 catalyst is used as a fixed bed and is equipped with protective beds of the PC series. The catalyst can be regenerated 1–2 times during the service life.

ENGINEERING SERVICES

- ✓ Process audit of existing commercial hydrotreaters; issuing recommendations on unit performance improvement
- ✓ Development of process operating procedures for unit operation
- ✓ Pre-production technical assistance (pre-commissioning, catalyst loading and activation), supervision during startup and commissioning
- ✓ Hydrotreater operation monitoring
- ✓ Development of technical reports on operation of the process units with issuing the recommendations on further effective operation



AOK-75-53

CATALYST FOR METHANOL OXIDATION TO FORMALDEHYDE

APPLICATION

Iron-molybdenum catalyst for industrial-scale manufacturing of formaldehyde by methanol oxidation with atmospheric oxygen in tubular reactors. The gas mixture leaving the reactor is sent to an absorber, where formaldehyde is absorbed by water. The final product is an aqueous solution of formaldehyde stabilized with methanol (formalin) or urea formaldehyde concentrate (UFC).

Industrial-scale manufacturing process of formaldehyde over iron-molybdenum catalysts allows for the production of methanol-free formaldehyde at a significantly lower cost compared to conventional silver catalysts.

AOK-75-53 catalyst is available in ring-shaped tablets.

BENEFITS

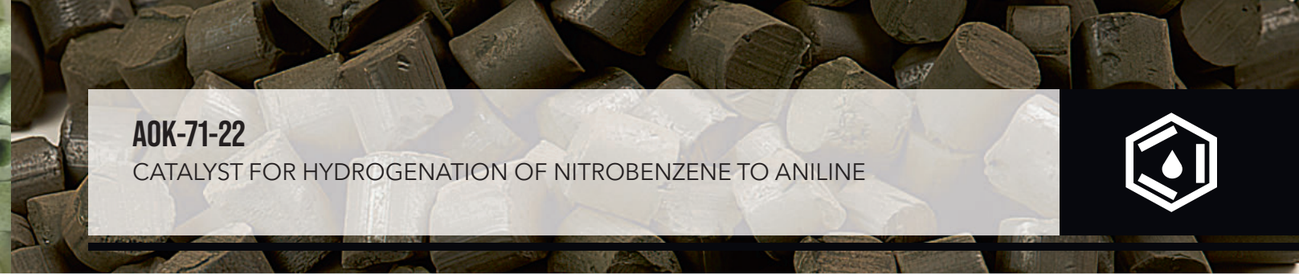
- High methanol conversion rate up to 99%
- High catalytic activity in the temperature range of 300–380°C
- Low methanol and formic acid content in the final product
- Lower catalyst cost due to silver-free composition
- Manufactured in Russia using proprietary technologies and domestic raw materials

ENGINEERING SERVICES

- ✓ Study of the physicochemical properties and performance of spent catalyst
- ✓ Development of a layer-by-layer catalyst loading scheme
- ✓ Loading of tubular reactors in accordance with the developed scheme using a special loading equipment
- ✓ Comparative study of the physicochemical and catalytic properties of catalysts from different manufacturers

PHYSOCHEMICAL PROPERTIES

Parameter	AOK-75-53
Shape	ring
Height, mm	4.1–4.6
Outer diameter, mm	4.6–5.1
Inner diameter, mm	1.8–2.1
Bulk density, g/cm^3	0.85–1.25
Surface area, m^2/g	3–9
Catalytic activity at 240°C	≥37
Conversion at 240°C, %	≥47
Selectivity at 290°C, %	≥90



AOK-71-22

CATALYST FOR HYDROGENATION OF NITROBENZENE TO ANILINE

APPLICATION

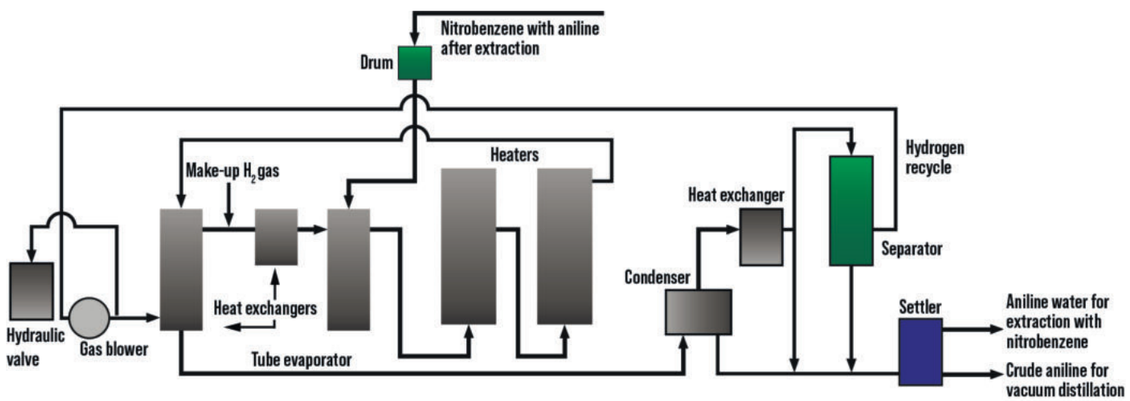
Catalyst is intended for aniline synthesis by nitrobenzene hydrogenation. AOK-71-22 is applied in the production of dyes, medicines, and intermediates for polyurethanes.

BENEFITS

- High catalytic activity in the temperature range of 200–300°C
- Resistance to water vapor
- Thermally stable up to 500°C
- High mechanical strength

PHYSOCHEMICAL PROPERTIES

Parameter	AOK-71-22
Shape	cylinders
Color	black
Diameter, mm	5±1
Length, mm	4-8
Bulk density, g/cm^3	1.5±0.15
Crush strength, MPa	≥4.5



NITROBENZENE HYDROGENATION

ICT-31-1, ICT-32-1

APPLICATION

Catalysts are applied for methionine production in chemical industry.
In the first stage of the process, in the presence of the ICT-31-1 catalyst, methyl mercaptan (MM) is synthesized via reaction between hydrogen sulfide and methanol:

$$CH_3OH + H_2S \rightarrow CH_3SH + H_2O \quad (1)$$

In addition to reaction (1), a number of side reactions occur in which dimethyl sulfide is formed:

$$2CH_3OH + H_2S \rightarrow (CH_3)_2S + 2H_2O \quad (2)$$

Dimethyl sulfide accumulates, is separated, or fed into a subsequent reactor and over ICT-32-1 catalyst in excess of H_2S, dimethyl sulfide is converted to MM by the following reaction

$$(CH_3)_2S + H_2S \rightarrow 2CH_3SH \quad (3)$$

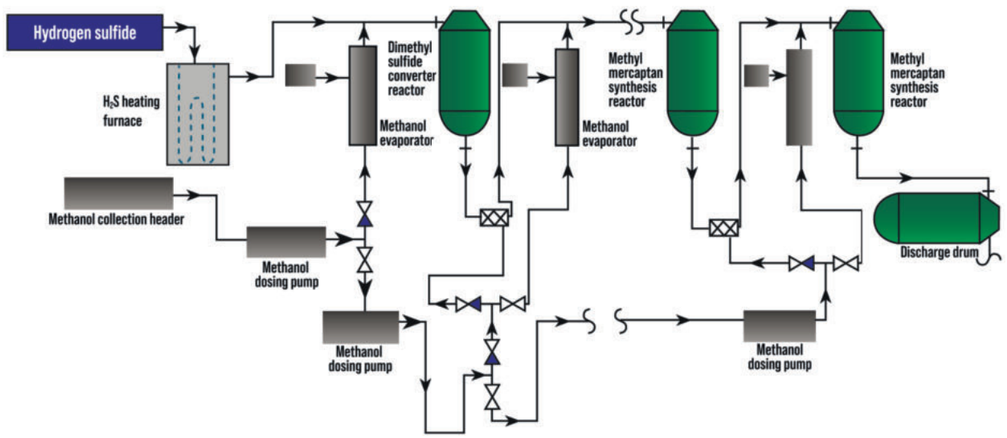
The process is carried out in the temperature range of 280-450°C, a pressure of 1-39 atm, and a molar ratio of H_2S:dimethyl sulfide=1:50.

METHYL MERCAPTAN SYNTHESIS

The synthesis of methyl mercaptan and dimethyl sulfide is carried out in eight series reactors. The first dimethyl sulfide converter reactor is loaded with activated alumina (ICT-32-1 catalyst). Hydrogen sulfide for the synthesis of methyl mercaptan and dimethyl sulfide is preheated in the furnace.
Process gas from the first reactor is fed sequentially to the other reactors loaded with ICT-31-1 catalyst. Methanol is fed evenly into each reactor from a methanol collection header via dosing pumps.
The temperature of the process gas at the reactor outlet, which rises due to the exothermic reaction, is maintained at 380°C. After the eighth reactor, the process gas condenses and undergoes separation.

BENEFITS

- Physicochemical properties and performance of the catalysts are competitive to world best counterparts
- High activity and selectivity in methyl mercaptan synthesis
- Improved chemical composition
- High strength



METHYL MERCAPTAN SYNTHESIS

METHYL MERCAPTAN SYNTHESIS CATALYSTS FOR METHIONINE PRODUCTION

PHYSICOCHEMICAL PROPERTIES

Parameter	Counterpart	ICT-31-1
Shape	spheres	
Color	white	
Diameter, mm	4–6	4.0–6.3
Bulk density, g/cm^3	0.74	≤0.95
Surface area, m^2/g	≥285	250±50
Crush strength, MPa	≥4.7	≥3.5

Parameter	Counterpart	ICT-32-1
Shape	spheres	
Color	white	
Diameter, mm	4–6	4.0–6.3
Bulk density, g/cm^3	0.55–0.60	≤0.80
Surface area, m^2/g	280–350	250±50
Crush strength, MPa	5-6	≥5

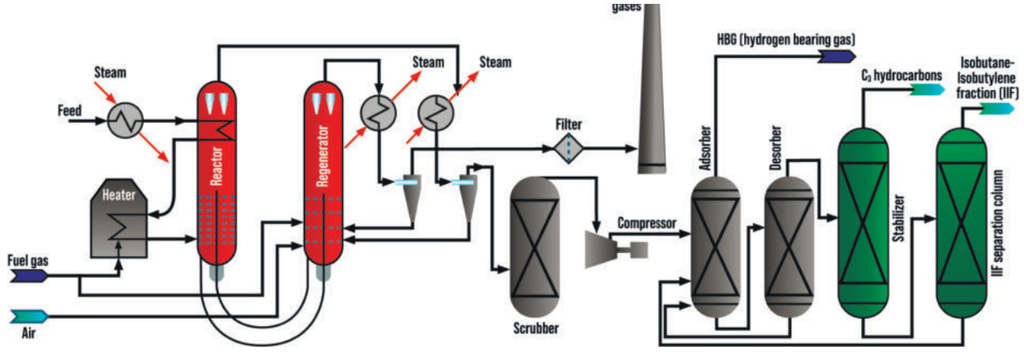
C_3-C_5 FLUIDIZED HYDROGENATION OVER CHROMIA-ALUMINA CATALYST

Benefits of the fluidized dehydrogenation vs other catalytic dehydrogenation processes:

- Intensive mixing in fluidized bed reactors ensures operating conditions close to isothermal process
- The fluidized bed intensifies heat and mass transfer processes
- The technology features reduced capital and operating expenses
- The technology is characterized by low cost of final products

R&D SERVICES

- Research and measurement of the physicochemical properties of catalysts
- Measurement of fluidization uniformity for fresh and equilibrium catalysts, as well as their mixtures
- Measurement of catalytic activity, including in the presence of impurities
- Study of the kinetics of oxidation and catalyst reactivation depending on the nature of the reducing agent
- Study of the effect of the reducing agent nature on the catalyst performance and physicochemical properties
- Engineering design for dehydrogenation units
- Mathematic simulation
- Calculation and simulation of catalyst distribution across reactor and regenerator sections (based on the field data)
- Tailoring the catalyst PSD
- Tailoring the open space of the grids
- Calculation of mass and heat balance for the dehydrogenation unit
- Performance evaluation for stripping and reduction zones
- Design and tailoring of regenerator performance
- Design and tailoring of inner and outer cyclones
- Integrity evaluation of cyclones (including checking inner surface for erosion)
- Calculation and design basis for recovery boilers
- Tailoring performance of the catalyst transport system



DEHYDROGENATION OF LOWER PARAFFIN HYDROCARBONS

APPLICATION

Catalyst is applied in petrochemicals for isobutane fluidized dehydrogenation to produce monomers for synthetic rubber and MTBE (methyl tert-butyl ether) synthesis.

BENEFITS

- High catalytic activity in the temperature range of 540-610°C
- High strength of fixing the active component on the carrier, preventing entrainment of the active component
- Low consumption rate
- Low abrasion degree with high mechanical strength
- Uniform PSD ensures optimal hydrodynamic conditions in a fluidized-bed reactor
- Increased service life

ENGINEERING SERVICES

- ✓ Comprehensive process audit (inspections) of the units
- ✓ Study of the composition and properties of the feed and catalyst used
- ✓ Basic Process Design
- ✓ Mathematic simulation
- ✓ Feasibility study for the reconstruction or replacement of the catalyst
- ✓ Design Basis for construction, reconstruction, and tailoring of dehydrogenation units
- ✓ Author's supervision of construction, reconstruction, and tailoring of dehydrogenation units
- ✓ Author's supervision of start-up and bringing performance to the guaranteed values (commissioning)
- ✓ Author's lifecycle online supervision

PHYSICOCHEMICAL PROPERTIES

Parameter	AOK-73-24
Shape	microspheres
Color	gray-green
Particle size distribution (PSD)	custom-tailored
Bulk density, g/cm^3	1.0–1.4
Surface area, m^2/g	100–160
Catalytic activity at 570°C	
- isobutane conversion, %	≥50
- selectivity to isobutylene, %	≥88

AOK-63-32

VOC ADSORBENT

APPLICATION

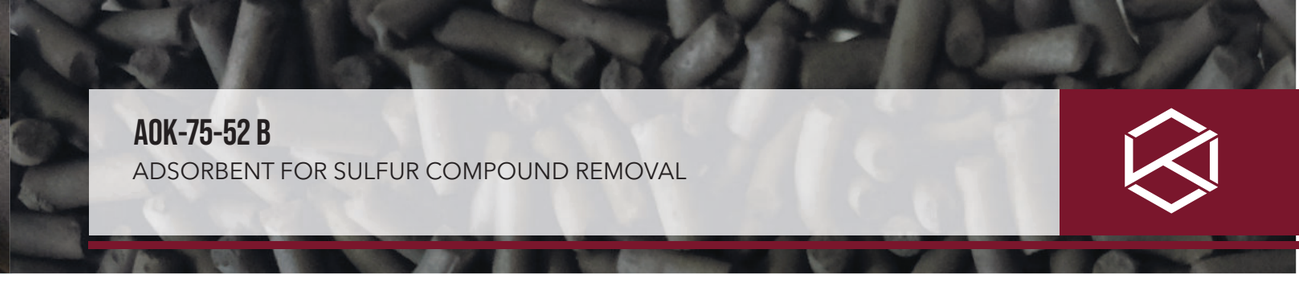
Adsorbent is applied for organic compound removal from industrial emissions in chemical, refining, nitrogen production and pharmaceuticals using adsorption and adsorption-catalytic technologies.

BENEFITS

- Intended for removing aromatics, aldehydes, and alcohols from gas mixtures
- Applied in dry and wet reaction conditions
- Over 17 years of operating experience

PHYSICOCHEMICAL PROPERTIES

Parameter	AOK-63-32	
	Grade A	Grade B
Shape	cylinders	rings
Color	black	
Length, mm	4–15	6–10
Outer diameter, mm	4.5–5.5	6.5–8.5
Wall thickness, mm	–	2–3
Bulk density, g/cm^3	0.55-0.85	
Surface area, m^2/g	≥450	≥400
Crush strength	≥3 MPa	≥5 N/mm



AOK-75-52 B

ADSORBENT FOR SULFUR COMPOUND REMOVAL

APPLICATION

The adsorbent is used in the gas and oil refining for wide range of solutions in chemical, petrochemical, and metal plants.

PURPOSE

Adsorbent is intended to remove sulfur compounds (hydrogen sulfide, COS, mercaptans) from gas streams, including natural gas, hydrogen-bearing gases, and streams of liquid and liquefied hydrocarbons.
The adsorbent is manufactured in SKTB Katalizator JSC facilities by the proprietary process. AOK-75-52 B is produced as cylindrical extrudates; optionally quadralobes are available.
The variety of adsorbent shapes allows you to select the optimal load in terms of removal efficiency and hydraulic resistance. Has been operated in APG (associated petroleum gas) treatment plants.

PERFORMANCE DATA

- Removal efficiency for hydrogen sulfide, COS, mercaptans is highly competitive to world analogues
- Resistant to condensed moisture
- High strength, lower bulk density
- No dust and chips during the operation

AOK-63-21

ALUMINA

APPLICATION

The alumina is used as a polar adsorbent for the separation of high-purity organic substances from mixtures by liquid column chromatography. AOK-63-21 is highly demanded in pharmaceuticals and analytical laboratories and research institutes. Due to its amphoteric properties, alumina can be modified to the required Brockman acidity.

BENEFITS

- Improved reproducibility of chromatographic separation due to the stable characteristics of the adsorbent
- Chemical and thermal stability of the adsorbent
- Contains high-purity aluminum oxide – over 96%
- Optimal particle size in the narrow range of 100–160 μm (customized upon request) ensures effective separation with minimal “tails”
- Low hydraulic resistance to flow due to minimal content of fine non-target fraction
- Low content of water and solubles
- Manufactured in Russia using proprietary technologies

APPLICATION

Alumina AOK-63-21 is used as an effective adsorbent in preparative liquid chromatography and thin-layer chromatography (TLC). AOK-63-21 is also intended for decolorizing aqueous and organic media. After use, the adsorbent can be easily separated from the liquid by filtration.

AOK-63-22

ALUMINA ADSORBENT

APPLICATION

The adsorbent is applied for drying compressed air of inert and process gases as well as for drying transformer oils and fine drying of organic liquids in chemical, petrochemicals, nitrogen and machinery manufacturing.

BENEFITS

- High resistance to dripping liquids, unlike silica gel and zeolite-based desiccants
- Resistance to temperatures up to 500°C allows multiple high-temperature regeneration of the desiccant
- The variety of pellet shapes (cylinders, balls, rings) allows specific drying tasks to be solved

PHYSICOCHEMICAL PROPERTIES

Parameter	AOK-63-22			AOK-63-22K	AOK-63-22C
	Grade O-1	Grade O-2	Grade O-3		
Shape	cylinders			rings	spheres
Color	white			white	
Length, mm	–	≤30	–	7.5±2.5	–
Outer diameter, mm	3.0±0.5	5.0±1.0		7.5±1.0	5.0±1.0
Inner diameter, mm	–	–	–	≥2,0	–
Bulk density, g/cm^3	0.70±0.15	0.65±0.15	0.70±0.15	0.70±0.15	
Surface area, m^2/g	≥250		≥200	≥200	
Crush strength	≥3.5 N/mm	≥3.0 N/mm		≥7.0 MPa	≥5.0 MPa
LOI (Loss on ignition), %	≤5,0			≤5,0	
Moisture capacity, cm^3/g	0.50±0.15			0.50±0.15	
Impurities, wt.%					
Iron, %	≤0.05		≤0.1	≤0.05	
Sodium oxide, %	≤0.1		≤0.3	≤0.1	

AOK-63-14

ALUMINA

APPLICATION

AOK-63-14 is applied for the production of mineral and composite sorbents in pharmaceuticals.

PURPOSE

The alumina offers a high surface area and sufficient purity to be used as a sorbent base or catalyst carrier.

BENEFITS

- Optimal and stable PSD
- Low water content due to high-quality heat treatment
- Low concentration of solubles
- Manufactured in Russia using proprietary technologies

AOK-63-40

SPHERICAL ALUMINA

APPLICATION

Alumina carrier for catalysts, sorbent.

BENEFITS

- High mechanical strength
- Low impurity content
- Extended surface

PHYSICOCHEMICAL PROPERTIES

Parameter	AOK-63-40
Shape	sphere
Color	white
Diameter, mm	1.6–2.0
Target fraction, wt. %, min	90
Bulk density, g/cm^3	0.75±0.15
Surface area, m^2/g, min	150
Total pore volume (moisture capacity), cm^3/g, min	0.5
Crush strength, average, N/pellet, min	40
Phase composition	γ-Al_2O_3

AOK-63-41

CCR (MOVING-BED REFORMING) CATALYST SUPPORT

APPLICATION

Alumina support for refining catalysts.

BENEFITS

- Enhanced mechanical strength and sphericity
- Variable bulk density and size
- Improved porous structure
- Extended surface
- Tin-based promotor

PHYSICOCHEMICAL PROPERTIES

Parameter	AOK-63-41		
	Grade A	Grade B-1	Grade B-2
Shape	sphere		
Color	white		
Diameter, mm	1.6–1.8		1.8–2.0
Target fraction, wt.%, min	80		
Bulk density, g/cm^3	0.53–0.57	0.63–0.67	
Surface area, m^2/g, min	180		
Total pore volume (moisture capacity), cm^3/g, min	0.5		
Crush strength, average, N/pellet/min	32		
Sphericity (ratio of the minimum to the maximum Feret diameter), min	0.88		
Tin wt.%	0.25–0.32		
Phase composition	γ-Al_2O_3		

IC-3-12

CATALYST FOR OXYGEN HYDROGENATION

APPLICATION

The catalyst is intended for selective oxygen reduction. Applied in caprolactam production to remove oxygen from nitrous gases at the stage of hydroxylamine sulfate synthesis.

BENEFITS

- High activity and selectivity of the catalyst in removing oxygen from nitrous gases
- Enhanced surface area
- High mechanical strength
- More than 20 years of production experience

PHYSICOCHEMICAL PROPERTIES

Parameter	IC-3-12	
	Grade A	Grade K
Shape	cylinders	rings
Length, mm	10–20	5–10
Outer diameter, mm	4.5–5.5	7–8
Inner diameter, mm	–	2–3
Bulk density, g/cm^3	0.8–1.2	
Surface area, m^2/g	≥150	
Crush strength	≥3.0 MPa	≥3.0 N/mm

AOK-71-31

CATALYST FOR NATURAL GAS
CONVERSION FOR INERT GAS BLANKETING

APPLICATION

The catalyst is designed for inert gas blanketing by natural gas conversion.
Applied in thermal and chemical-thermal treatment of metal parts in a fluidized catalyst bed.

BENEFITS

- Enhanced attrition resistance
- High catalytic activity and thermal stability
- Homogeneous particle size distribution

PHYSICOCHEMICAL PROPERTIES

Parameter	AOK-71-31
Shape	small-sized spheres
Color	light blue, grey
Bulk density, g/cm^3	0.7–0.9
Surface area, m^2/g	≥150
Loss on attrition after 30 min, %	≤9.0
PSD (particle size distribution):	
- from 0.4 to 1.0 mm, %	≥90
- < 0.4 mm, %	≤4

CORPORATE VIDEOS

About Us

Industrial Ecology

Sulfur recovery (Claus process)

Dehydrogenation Technologies

Competence Center for
Dehydrogenation Process